



**Bangladesh – India Friendship Power Company (Pvt.) Limited**  
**(A Joint Venture of NTPC Ltd. and BPDB)**

*Monitoring of Environment Parameter and Implementation of Environmental Management Plan during Construction Period along with Engineering Activities for 2X660 MW Maitree Super Thermal Power Project at Rampal in Bagerhat District*

## **22<sup>nd</sup> Quarter Monitoring Report**

**Monitoring Period: August 2019 - October 2019**

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**February 2020**



**Monitoring of Environment Parameter and Implementation of  
Environmental Management Plan during Construction Period Along  
with Engineering Activities for 2x660 MW Maitree Super Thermal  
Power Project at Rampal, Bagerhat**





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## **Abbreviations and Acronyms**

AAS	Atomic Absorption Spectrophotometer
AECL	Adroit Environment Consultants Ltd
As, Pb, Hg	Arsenic, Lead and Mercury
BCSIR	Bangladesh Council of Scientific and Industrial Research
BDS	Business Development Studies
BIFPCL	Bangladesh-India Friendship Power Company (Pvt.) Limited
BOD	Biochemical Oxygen Demand
BPDB	Bangladesh Power Development Board
BUET-BRTC	Bangladesh University of Engineering and Technology - Bureau of Research, Testing and Consultation
CDM	Clean Development Mechanism
CEGIS	Center for Environmental and Geographic Information Services
COD	Chemical Oxygen Demand
CPUE	Catch per Unit Effort
CSR	Corporate Social Responsibility
dBH	Diameter at Breast Height
DCR	Duplicate Carbon Receipt
DO	Dissolved Oxygen
DoE	Department of Environment
DPHE	Department of Public Health Engineering
EC	Electrical Conductivity
ECR	Environment Conservation Rules
EHS	Environmental Health Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPC	Engineering Procurement Construction
ESP	Exchangeable sodium percentage
FGD	Focus Group Discussion
FGD	Flue Gas Desulfurization
FSR	Fisheries Species Richness
GIS	Geographic Information System
GoB	Government of Bangladesh

GPS	Global Positioning System
GW	Groundwater
HS	Household Survey
IFC	International Finance Corporation
IGA	Income Generation Activities
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
Kg	Kilogram
KII	Key Informants Interview
MoPEMR	Ministry of Power, Energy and Mineral Resources
MW	Mega Watt
MSDS	Materials Safety Data Sheet
NTPC	National Thermal Power Corporation
OHSAS	Occupational Health and Safety Management Systems
PCU	Passenger Car Unit
PGCB	Power Grid Company of Bangladesh Ltd
PMU	Project Management Unit
PRA	Participatory Rural Appraisal
PWD	Public Works Department
QMR	Quarterly Monitoring Report
RRA	Rapid Rural Appraisal
RS	Remote Sensing
SAR	Sodium absorption ratio
SRDI	Soil Resources Development Institute
SRF	Sundarbans Reserve Forest
TDS	Total Dissolved Solid
TH	Total Hardness
ToR	Terms of References
TSS	Total Suspended Solid
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

## Units

dB	Decibel
hr	Hour
Kg	Kilogram
Km	Kilometre
KV	Kilo Volt
KW	Killo Watt
m	Meter
mg	Milligram
MW	Mega Watt
Nm	Normal Meter
ppm	parts per million
ppt	parts per trillion
ton/year	Ton Per Year
s	Seconds

## Units Conversion Table

### General Units

$1^{\circ}\text{C} = 274.15 \text{ K} = 33.8^{\circ} \text{ F}$   
1 hectare =  $10^{-2} \text{ km}^2 = 2.471 \text{ acres}$   
1 kilogram = 2.20 pound  
1 kilometre = 0.62137 mile  
1 liter = 0.001 cubic meter  
1 meter = 3.2808 feet  
1 metric ton = 1000 kg  
  
 $1 \text{ mg/L} \approx 1 \text{ g/m}^3 \approx 1 \text{ ppm (w/w)}$   
 $1 \text{ mg/m}^3 = 1 \mu\text{g /L}$   
1 pascal =  $1 \text{ N/m}^2 = 0.01 \text{ millibar}$   
1 square mile = 640 acre =  $2.590 \text{ km}^2$

### Energy Units

$1 \text{ GWyr} = 8.76 \times 10^9 \text{ kW}$   
1 horsepower = 746 W  
1 KWh = 3412 Btu  
1 kWh = 859.85 kcal  
 $1 \text{ KWh} = 3.6 \times 10^6 \text{ J}$   
 $1 \text{ MW} = 1000 \text{ KW} = 10^6 \text{ W}$



## Glossary

<i>Aman:</i>	Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec. Mostly rain-fed, supplemental irrigation needed in places during dry spell.
<i>Aus:</i>	Group of rice varieties sown in the pre-monsoon season and harvested in the monsoon season. These are broadcasted/transplanted during March-April and harvested during June-July. Generally, rain-fed, irrigation needed for HYVT. (High yield variety) Aus.
<i>B Aus:</i>	Broadcast Aus
<i>Bazar:</i>	Market
<i>Beel:</i>	A saucer-shaped natural depression, which generally retains water throughout the year and in some cases seasonally connected to the river system.
<i>Boro:</i>	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
<i>Haat:</i>	Market place where market exchanges are carried out either once, twice or thrice a week, however not every day.
<i>Gear/Jaal:</i>	Different types of fishing net to catch fish from the water bodies.
<i>Kutcha:</i>	A house made of locally available materials with earthen floor, commonly used in the rural areas.
<i>Khal:</i>	A drainage channel usually small, sometimes man-made through which the water flows. These may or may not be perennial.
<i>Kharif:</i>	Pre-monsoon and monsoon growing season. Cropping season linked to monsoon between March-October, often divided into kharif-1 (March-June) and kharif-2 (July-October).
<i>Perennial Khal:</i>	Water available in the khal all the year round.
<i>Pacca:</i>	Well-constructed building using modern masonry materials.
<i>Rabi:</i>	Dry agricultural crop growing season; mainly used for the cool winter season between November and February.
<i>Seasonal Khal:</i>	Water not available in the khal all the year round.
<i>T. Aman:</i>	Transplanted Aman
<i>Upazila:</i>	Upazila is an administrative subdivision of a District.





## Executive Summary

This 22<sup>nd</sup> quarterly monitoring report covers the recent status of EMP (Environmental Management Plan) implementation during construction stage as recommended in the EIA (Environmental Impact Assessment) study vide Memo No: DoE/Clearance/5062/2011 dt. 05/08/2013 and EIA report of Coal Transportation vide Memo No: DoE/Clearance/5532/2016 dtd.31/01/2018. Accordingly, the CEGIS team carried out the monitoring activities in November, 2019 covering every monitoring aspects as assigned in the ToR (Terms of Reference) and approval conditions from DoE along with valuable suggestions and recommendations from different national and international organizations. In other words, the aspects can briefly be addressed as monitoring of the Environmental Compliances and monitoring of the selected environmental parameters such as ambient air quality, noise level, water quality, land resource, traffic management status, water resources management status, chemical properties of river bed materials, agricultural resources monitoring, fisheries resources, Socio-economic monitoring, aquatic & terrestrial ecosystem monitoring and the Sundarbans Reserve Forest (SRF) health monitoring.

The progress of Project implementation activities includes extension and development of internal road network, jetty construction activities, construction key components, mechanical and civil infrastructure development works etc. In this quarter, the environmental due diligence covers the Environmental Management System Action Plan, Occupational Health and Safety & Workers' wellbeing, Biodiversity and Sustainable Management of Natural Resources etc. The monitoring team observed that, the BIFPCL is typically complying with the EMPs as suggested in the EIA report of the Power Plant as well as in the EIA report of Coal Transportation. In addition, the Monitoring team has also checked the approval conditions of DoE for sustainable implementation of the project. Moreover, as an Environmental Monitoring agency, CEGIS has recommended few measures as per EMP to be complied for ensuring environmental and social safeguarding of the study area.

The recommendations included adequate suppression of dust, protection or treatment of waste water from the labour colony to nearby water bodies (Maidara khal), management drainage network, limiting extraction of groundwater, green belt development, raising awareness among the workers for using appropriate PPEs, proper implementation for worker's association and insurance policies, placement of sufficient coloured disposal bins at the appropriate locations and most importantly, the continuous occupational and health safety monitoring by the project proponent.

Currently, all of the project aspects like Occupational Health and Safety Policies; Establishment of the grievance redress mechanism; Emergency preparedness and response plan; Fire safety plan; Stakeholder Engagement Plan etc. are all being implemented as recommended. On the other hand, the EPC contractor is maintaining the specific measures/initiatives for avoiding the accidental events among which strengthening the OHS department, arranging robust training sessions, employing lockout/ tag out procedures, Inspection of all machineries, equipment and tools to ensure that they are in good working order, blocking off areas where heavy machinery or vehicles are being used, ensuring license or proper training for workers/drivers/operators/supervisors to operate machineries, equipment and tools, vehicles etc are mentionable. They are now documenting the daily monitoring of EMP implementation activities like use of PPEs, noise level monitoring and

water sprinkling at the sensitive places. However, it was also recommended that continuation of the waste management system; Site specific ESMPs; Safety training programs for the Project personnel may reduce any kind of health as well as environmental hazards in the project area.

During this tier, all the preselected parameters were measured at all the preselected locations. All the measured values of all air quality parameters for all locations were found well below the standard limit set by ECR' 2005. No significant changes were observed among the concentrations of air pollutants for each location. But due to the less precipitation during the monitoring period, the concentration of the major air pollutants was found comparatively higher than the previously monitored data of the same seasons. It can also be noted that, the concentrations of major air pollutants were found comparatively lower in Sundarbans area than the other monitored areas. However, according to the measured values it can be easily said that, the present air shed is not a degraded airshed as no significant exceedances or variation has ever been recorded among the concentrations of criteria pollutants.

On the other hand, traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles were the anthropogenic sources of noise. However, the observed noise level was not found to exceed the Bangladesh standard limit of noise levels at eleven locations during this monitoring (22<sup>nd</sup> quarter) season. The observed noise levels at Chunkuri-2 (Bajua) located at 4km South West direction from the chimney location was found to exceed the Bangladesh standard limit of standard values. In course of the total twenty-two monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons. However, the noise generation sources in the study area can mainly be divided into two types; one is natural and the other one is anthropogenic. Natural sources of noise generation were birds' chirping, stormy wind, wave breaking on the shoreline, howling of leaves and so on.

Meanwhile, the physico-chemical properties of Passur River changes with tidal intrusion in different seasons. In the 22<sup>nd</sup> quarter (Post-monsoon 2019), only salinity was recorded comparatively higher but still under the recommended value of ECR'1997. In contrary, pH, Temperature and DO (Dissolve Oxygen) level was found favorable for the residing aquatic life forms. Huge construction activities and land filling near the bank side didn't reduce the DO level at all. During 21<sup>st</sup> quarter (Monsoon, 2019) monitoring, lab tested parameters, TDS (Total Dissolve Solid) and TSS (Total Suspended Solid) did not increase in respect to the same seasons of last five consecutive years. However, TH (Total Hardness) was found extremely higher than other monsoon seasons which might be because of tidal intrusion during monsoon and less freshwater availability. COD (Chemical Oxygen Demand) was found low in concentration in most of the monitoring sites except for a few. Nitrate ( $\text{NO}_3^-$ ) and sulphate ( $\text{SO}_4^{2-}$ ) was comparatively low in concentrations rather than other seasons. Phosphate ( $\text{PO}_4^{3-}$ ) concentrations showed slightly higher than the Standard value of Inland Surface Water Quality (0.05 mg/L) especially at some of the areas adjacent to the power plant. It was also found that,  $\text{PO}_4^{3-}$  was coming from the agricultural practices, surface run-off from upstream and plankton decay in the river itself rather coming from construction activities.

In case of metal pollution, no variation was recorded for as (Arsenic), Pb (Lead) and Hg (Mercury) concentration and even no issues were observed as well. Oil & grease

concentration was found less than 5 mg/L, which is even less than half of the recommended concentration (10 mg/L) for Inland Surface Water.

Lastly, organic pollution was found undetectable in Passur-Sibsa RS (River System) especially for TOC and PAHs. It was also observed that the physical characteristics of groundwater quality is still in good condition and in acceptable state for drinking purpose. Dissolved and solid contents were also found lower than the highest recommended limit set for Bangladesh. Only, chemical oxygen demand during 2014 and 2015 was higher than ECR, 1997. Other nutrients like nitrate, sulphate and phosphate comply completely with the Bangladesh standard limit together with the metals of arsenic, lead and mercury.

Besides, the soil samples were collected during the monitoring period and were immediately sent to SRDI, Dhaka laboratory for analysis. The analyzed results will be incorporated in next quarterly report. Local Aman was planted at all the monitoring locations except for Kapalirmet where no agricultural practice was found. On the other hand, impact of cyclone Bulbul was observed at Barnapara only. Here, the production might be reduced due to this impact. No specific impact was drawn for livestock during this monitoring.

At the same tier the traffic surveys were carried out at three preselected locations around the project site namely Khudir Bottola and Digraj at Khulna Mongla Road and Ichamoti Bridge at Power Plant access road. Traffic volume and traffic nature at all the three surveyed locations were found similar to the earlier findings during the construction period. The analysis data represents that the Khulna-Mongla Highway receives the largest number of vehicles, compared to other surveyed roads. It was also observed that the vehicular movements during the survey were mostly for the regular activities in the surveyed region and construction activity of the MSTPP results in a limited number of vehicular movements on the surrounding road network.

On the contrary, the 22<sup>nd</sup> quarterly monitoring for fisheries resources was conducted at 13 sampling sites which were set at the inception stage. Amongst the effective sites, four (04) were in the river and three (03) were in the country side (shrimp farms). The changes in habitat uses were observed in every past fiscal year along with the current one (as compared to the fiscal year of 2014-2015, 2015-2016, 2017-2018 and 2018-2019) and may be caused mainly due to biophysical changes like tidal effect, forest erosion and vegetation coverage, seasonal variability, food availability and also fisheries management practices.

Moreover, through analyzing the type of habitat uses by different age group of fish species (based on the length-based community structure model) two types of habitats were found i.e. i) spawning and nursery ground and ii) omni-ground. The omni-ground is comprised of other two habitats such as (a) feeding ground and (b) ground for maturation. Shannon-Weiner diversity index was also observed to vary between 22<sup>nd</sup> quarterly tier with that of all previous quarters. Highest Shannon-Weiner index was found at the Chandpai point (0.81) indicating moderate evenly distribution of fish species. On the other hand, lowest evenness was found at the Chalna Point (0.5). However, maximum FSR was obtained in the Chandpai point (n=11), while very low FSR was recorded at the Chalna Point (n=9). Fries of fin fish were found dominated at Chandpai point and juveniles to adult age group were found dominated at Mongla, Maidara and Chalna Point of the Passur River system. Among the fish species, Bailla attains the maximum abundance in the migratory fish species as observed during the period. Moreover, among migratory species Paissa, Ilish, Gharua, Chela and Chapila were observed to migrate long distances. The highest productivity was observed in the Gher of Kapashdanga followed by Bhekatkhali Khal, Rajnagar and Chunkuri-2. The present study

revealed that the highest catch susceptibility was found in case of Ilish Jal (0.8 kg/haul). The Ilish Jal was most frequently used in upper reaches in the Passur River System.

In course of the ecological monitoring, vegetation composition, plant diversity, canopy status, plant health, bird habitat status and dolphin occurrences in rivers were monitored. A total 52 no. of tree species were recorded from all the monitoring sites with a Shanon-Winner diversity index of 2.78. Canopy status of two studied homestead vegetation has slightly deteriorated due to recent cyclone hits and development activities by the house owners. Status of plant health also unchanged at most of the locations. Population of local Migratory bird's species were found reduced for changing of land use practices. It was also observed that the winter migratory birds are facing disturbeness from vehicular movement on the approach road, construction noise and excess lighting in night at plant site. Similarly, Dolphin occurrences were recorded at Passur and Maidara River and at some connected tributaries of Passur River like Shella Gang, Dhangmari and Bhadra Khal. The occurrence was found higher at Bhadra Khal followed by Shella Gang and then Dhangmari Khal.

Moreover, in light of Rampal Power plant installation, the authority took initiative to monitor Sundarbans forest health periodically along the Passur River. Various bio-indicators such as tree growth, species diversity, seedling regeneration capacity, pneumatophore occurrence, crab hole density, canopy cover changes, Leaf Area Index, leaf phenology, pest and diseases were observed in the permanent sample plots (PSPs) along the Passur River over time. Monitoring results showed that, Gewa (*Excoecaria agallocha*) was the dominant species among all the PSPs followed by Sundari (*Heritiera fomes*) and Kakra (*Bruguiera gymnorrhiza*). Species diversity indices showed that the sampling plots of Koromjol has more diversity compare to other PSPs. Considering the similarity in species composition it was found that, Akram point and Hiron point has similarity in species composition compare to Sutarkhali, Koromjol and Harbaria. There was no significant variation in tree growth, pneumatophores density, crab hole density, canopy cover changes, Leaf Area Index and canopy cover over the monitoring period for all the PSPs. That average tree diameter were found higher in Koromjol where as lower at Hiron Point. However, there is no significant in declining trend in tree growth was observed. Pneumatophores density was comparatively very low in Akram point whereas highest in Koromjol PSPs. Akram point canopy cover was lower compare to the rest of PSPs canopy cover percentage. However, no significant variation among sites were observed. Seedling and crab hole density among the studied plot was mostly similar and shows a slightly increasing trend. Seedling density was comparatively less in Akram point because of low seedling recruitment and survival rate. Among all the PSPs, Akram point has the highest crab holes whereas Hiron point has lowest number of crab holes. In case of Leaf Area Index (LAI), there was no significant variation observed among sites. No severe pest and disease attack were observed in the monitoring PSPs except top dying symptom of Sundari (*Heritiera fomes*). Phenological changes were not observed in all PSPs. Overall, it can be said that forest health along the Passur River is in stable condition (i.e. no detrimental condition) except top dying of Sundari (*Heritiera fomes*) tree species.

Furthermore, in course of socio-economic monitoring, it was found that about 20% of semi-skilled labors hired from nearby communities as reported by the proponent which creates more income generating opportunities for the local people. Accordingly, BIFPCL has made a plan to engage local people skilled/semi-skilled to recruit them in the near future. For avoiding accidental cases and ensuring a safe working environment, the PMU initiated plan

for a moto on “No training No work”. As a result, no worker couldn’t get the entrance without proven test on different safety issues. The training center established at the heart of the power plant premise which helping to ensure all labor’s training before joining to works.

Similarly, toolbox trainings were conducted by the safety manager and made working people prompt to contribute better in the construction with safer and good working environment. The PMU is very much concern about community health too. For protecting dust pollution, water is being sprayed four (4) times in a day. An air pollution monitoring machine installed by DoE to observe the air quality status. For avoiding public disturbance and ensure safety, night shift works were regulated, and use of heavy machineries were stopped to reduce the noise pollution. About 65,000 trees are planted to make a greenery environment and protect environmental pollution.

With those work, the PMU organized different programs and activities to provide CSR related contribution under the project. Under the CSR program, till now a total of 47, 623 people got free medical treatment under the different health campaigns held within and outside the project premises. Targeting to provide good quality water to the nearby communities, a Reverse Osmosis (RO) plant with the capacity of 1000 liter (per hour) was established at Burirdanga union for desalinizing of water. The capacity building program (under the CSR) is being continued. Till now, about 186 persons received training on sewing, and about 190 persons got the ICT skill development training.





# 1. Introduction

## 1.1 Background

As per the scope of works, the environmental components, social indicators and the implementation status of EMP (Environmental Management Plan) during the construction phase of 2x660 MW Maitree Super Thermal Power Plant are being broadly monitored. As suggested by DoE, an independent environmental monitoring team should be engaged for monitoring of Project related activities and has been set as mandatory in the EIA approval condition no. 32 and Coal Transportation EIA approval condition no. 17. In addition, as per approval of the EIA study of Coal Transportation from DOE Condition No. 26, “Additional environmental baseline data to be collected and incorporated in the monitoring report as suggested in the EIA report.

Subsequently, CEGIS was engaged for conducting the said activities to examine the status of environmental parameters and progress of the implementation of EMP for safeguarding the environment of the project influence area as well as Sundarbans Mangrove Forest and the surrounding ecosystem with its communities holistically.

The location of the proposed project encompasses Sapmari, Katakali and Kaigar Daskati Mauza of Rajnagar Union under Rampal Upazila of Bagerhat district (**Figure 1.1**). The Power Plant lies in between latitude 22° 37' 0" N and 22° 34' 30" N and longitude 89° 32' 0" E and 89° 34' 5" E. The Plant site is at about 23 km south from the Khulna City and near about 14 km in the north-west direction from the nearest tip of the Sundarbans (considering the proposed chimney location). Location of the study area and the relative distance from various World heritage sites are presented in **Figure 1.1**.

The study area includes: i) area covering 10 km radius from the Plant location, ii) area within 5 km strip from both banks of the Passur and the Sibsa rivers starting from the Plant site to Hiron point and is presented in **Figure 1.2**. According to the contract, the findings of the previously formulated quarterly monitoring reports have been submitted to BIFPCL. The current document constitutes the 22<sup>nd</sup> quarterly monitoring aspects covering all the preselected monitoring parameters and locations.

## 1.2 Objectives

The overall objective of the study is to monitor the important environment and social parameters during construction phase of the Power Plant. And the main objective is to monitor, the environmental compliances regarding EMP implementation during Power Plant's construction works and associated activities.

## 1.3 Criteria for Selection of Monitoring sites/locations

The monitoring sites have been selected considering the sensitive receptors and the ambience of the surroundings likely to be impacted from the Project related activities. These includes-

- Wind direction, wind speed, sensitive receptors in and around the vicinity of the Project site were considered to monitor the ambient air quality. Potential locations were also identified and selected for noise level monitoring. Similarly, sites for

water quality monitoring, were selected considering the water resources likely to be impacted by the project activities.

- Monitoring aspects and locations for fisheries resources consider the fish habitats, biodiversity, migration and production zones likely to be impacted by the project activities.
- Monitoring locations for ecosystem and biodiversity have also been selected considering the induced impacts of the Project.
- Soil and land resources monitoring locations and parameters have been selected considering the induced impacts by the project activities on the surrounding farming land.
- Monitoring of socio-economic conditions of the PAPs (Project Affected Peoples) and project surrounding communities are being carried out on the basis of their concurrent circumstances which are likely to be transformed and /or altered by the project activities.
- Locations for Sundarbans Reserve Forest (SRF) Health Monitoring have been selected considering the potential access routes of coal transportation through Sundarbans Forest area and associated activities for different phases of the power plant which may have effects on Sundarbans Reserve Forest area.
- Monitoring of Environmental compliances regarding EMP implementation status in and around the project area has been set in view of the approval conditions from DoE for ensuring environmental sustainability and social acceptability.



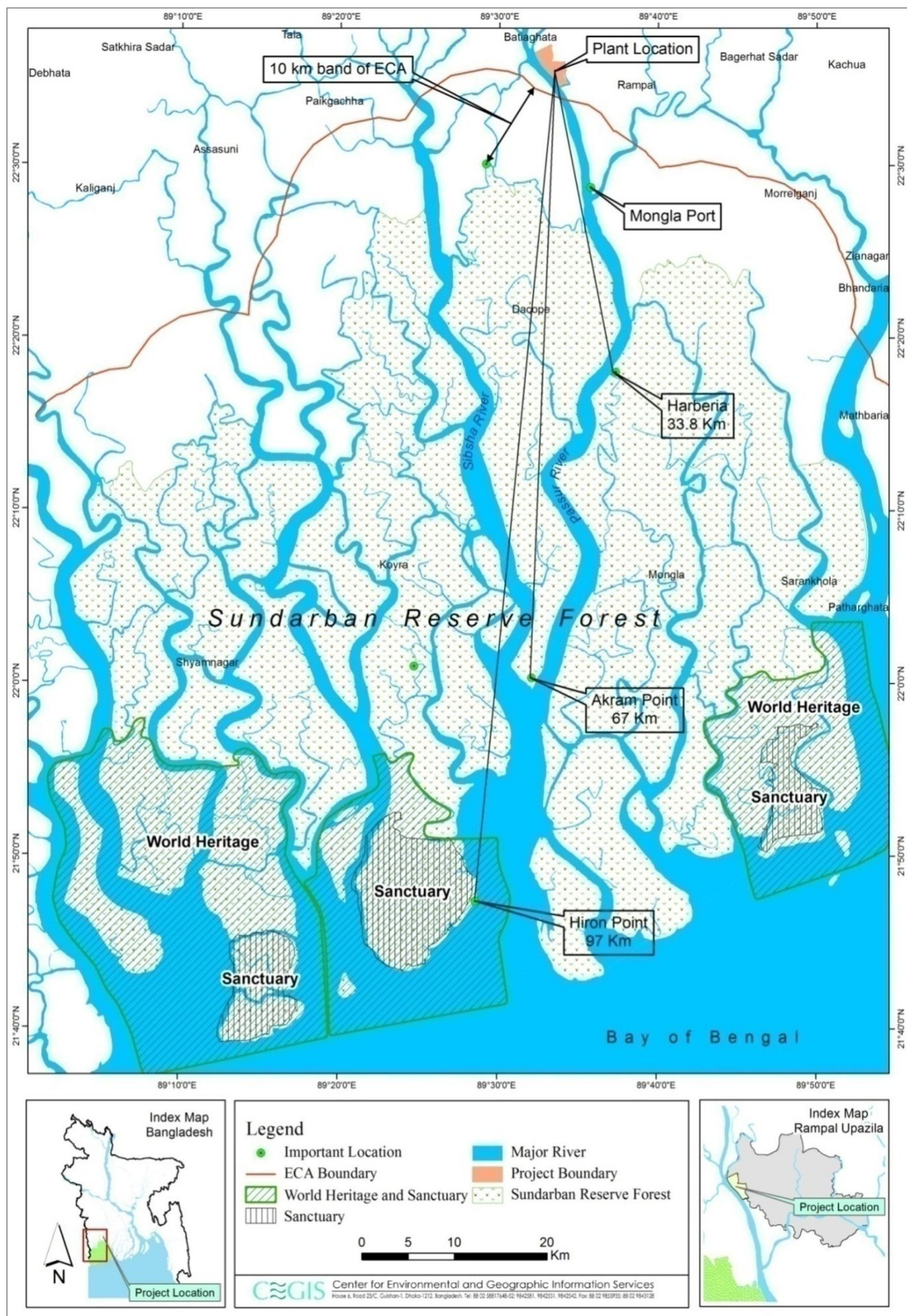


Figure 1.1: Location Map of the Study Area



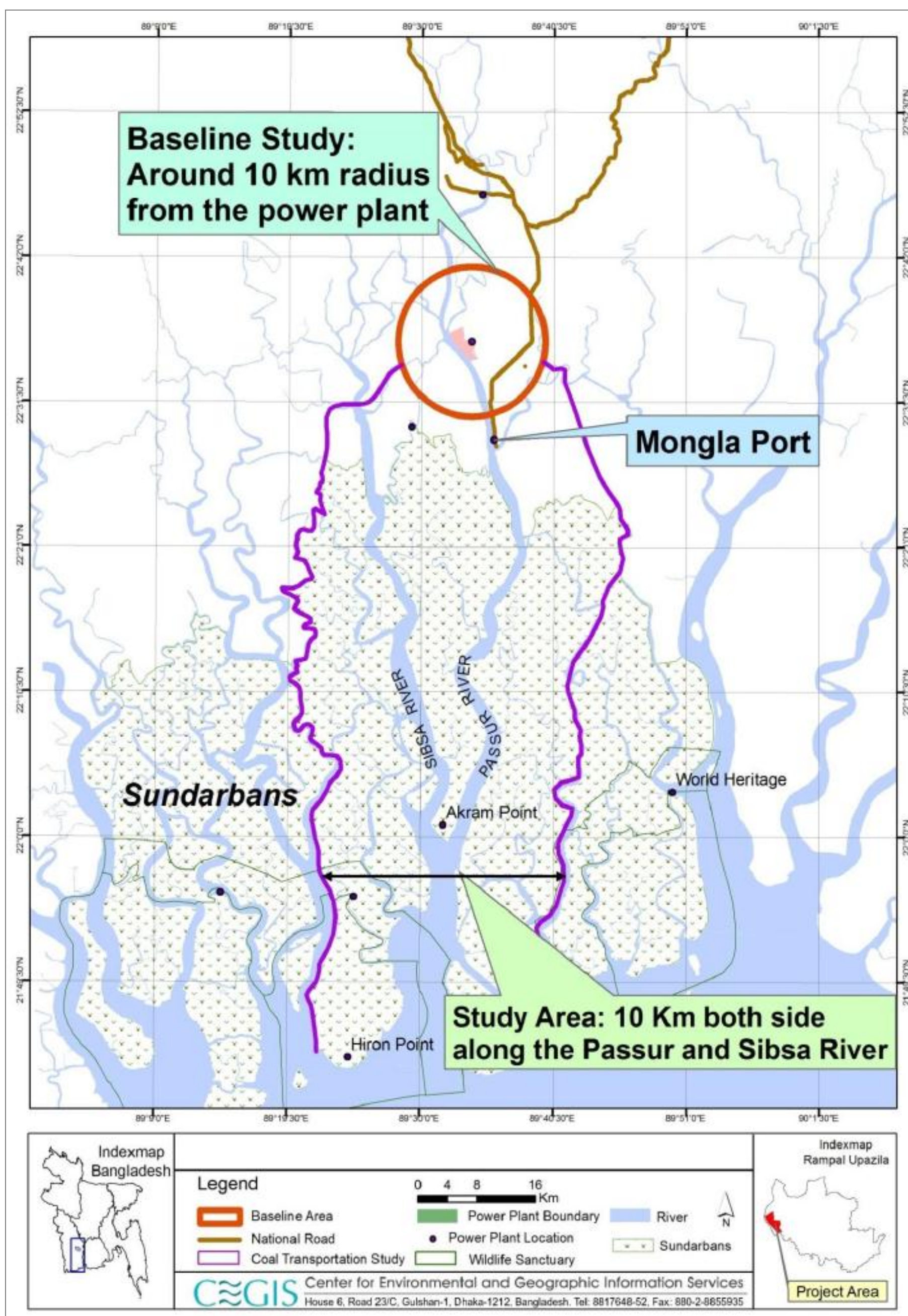


Figure 1.2: AOI of Environmental and Socio-economic Monitoring

## 1.4 Main stakeholders

### 1.4.1 Bangladesh Power Development Board (BPDB)

BPDB is the main promoter of BIFPCL and has been providing lateral support to BIFPCL in every phases of implementation (pre-construction, construction and operation) of the Maitree Super Thermal Power Plant. Moreover, BPDB i.e. is also ensuring the environmental compliance monitoring of different steps of the Power Plant construction.

### 1.4.2 Forest Department

Monitoring of the Sundarbans Reserve Forest area need to be addressed as the conditions set out by the DoE. Hence, permission from the Forest Department is essential to carry out the said activities. The Forest Department has been providing the permission under certain conditions i.e. keeping close communication with the Forest Department, submission of the monitoring report to the Forest Department along with the following activities:

- Inclusion of a Soil Scientist and a Botanist in the monitoring team,
- Monitoring of regeneration, in growths (seedlings), diseases and pests (if necessary, to carry out laboratory analysis),
- Monitoring of soil nutrients (macro, micro) and heavy metals,
- Monitoring of floral diversity, species richness and dominance,
- Measurement of carbon content both above and below the ground level,
- Assessment of impact on canopy cover, leaves phenology, flowers behaviour, pneumatophore and crab hole conditions.

However, BIFPCL forwards each copy of the earlier quarterly monitoring reports to the Chief Conservator of Forest, Bangladesh Forest Department, Agargaon, Dhaka and Conservator of Forest, Khulna Circle, Boyra, Khulna. Similarly, the report of 22<sup>nd</sup> quarterly monitoring will also be forwarded to the same officials of the corresponding Departments.

### 1.4.3 Department of Environment (DoE)

The monitoring plan, including indicators, parameters, location and schedule have been prepared and arranged by incorporating the suggestion(s) and approval conditions from both the Power Plant EIA study and Coal Transportation EIA study of the Department of Environment. The BIFPCL forwards the monitoring reports and data to DoE on a regular basis (Monthly and Quarterly). The monitoring reports are also presented to the Environmental Clearance Committee of the DoE during renewal of the site clearance. In addition, one representative from the local DoE office is involved in each monitoring visit to accompany the monitoring team.

### 1.4.4 Bangladesh India Friendship Power Company (Pvt.) Limited (BIFPCL)

Bangladesh India Friendship Power Company (Pvt.) Limited (BIFPCL) is the Project Proponent of the proposed Power Project. The official(s) of BIFPCL has been assisting the study team from the beginning of the study. In addition, BIFPCL is so far implementing the Environmental Management Plan (EMP) accordingly for ensuring environmental and social safeguarding of the Project surroundings including the Sundarbans Reserve Forest.



#### **1.4.5 Local Community**

The Project Affected Peoples (PAPs) are included in each of the social environment-monitoring program. The changes in important socio-economic indicators are examined through Focus Group Discussions (FGDs), KIIs and other informal discussions with local people in different locations of the project influenced area.

#### **1.4.6 Major component of monitoring study**

The Physical, Biological and Social aspects are monitored on regular basis and this quarterly monitoring report is furnished with the following subsequent chapters,

- Physical Environment which covers the aspects of air quality, noise level, water quality, Soil and land resources, traffic management and the morphological study;
- Biological environment which covers fisheries resources, ecological status, the Sundarbans Reserve Forest (SRF) health conditions;
- Socio-economic environment covers compensation, resettlement/rehabilitation, project related employment generation, labour and working condition, community health, security and safety, along with corporate social responsibilities.
- Environmental compliance monitoring includes Monitoring of Environmental and Social Management System Action Plan Implementation, Monitoring of labour and working conditions, Monitoring of community health, safety and security and Monitoring of biodiversity and sustainable management of living natural resources.

## 2. Physical Environment

### 2.1 Air Quality

The air quality parameters and locations were selected considering the major effects to be borne by the Project activities during pre-construction, construction and operation stages. During the recent visit, all the preselected parameters and locations were monitored including the Sundarbans Reserve Forest area.

### 2.2 Methodology

In general, there are five (5) major air pollutants i.e., Particulate Matters (PM<sub>2.5</sub>, PM<sub>10</sub>, and SPM), SO<sub>x</sub>, NO<sub>x</sub>, CO and O<sub>3</sub> are expected to be generated from the coal-based Power Plant activities i.e. pre-construction, construction and operation works. The monitoring locations as well as the indicators were selected during the EIA study based on a number of selective criteria e.g., the sensitivity of the receptors, project activities like movement of coal-carrying vessels, coal trans-shipment point; wind speed, wind direction, atmospheric deposition (Wet and Dry) and atmospheric stability classes. A comprehensive discussion on the recently assessed air quality has been reported in the following sections. It is also to be noted that, the air quality was monitored for eight (8) hours period at all the monitoring sites.

### 2.3 Method of Sampling and Laboratory Testing

Respirable Dust Sampler (Model-Envirotech India APM-460 BL) and Fine Particulate Sampler (Model-Envirotech India APM-550) were used to collect air samples from the selected sites. The PM<sub>2.5</sub>, PM<sub>10</sub>, and SPM were tested by gravimetric method. The concentration was analyzed by West-Gaeke method. Likewise, the concentration of NO<sub>2</sub> was tested by Jacob and Hochheiser method and concentration of CO and Ozone (O<sub>3</sub>) were measured by Metravi CO-10 meter and Tongdy O<sub>3</sub> Monitor respectively (**Figure 2.1**).

### 2.4 Pollution sources in the Sundarbans

The major air pollution sources currently contributing to the air pollution along the Passur River in between the Project site and Mongla Port area are the cement industries, LPG bottling plants and petroleum refinery industries and all commercial activities in this area. On the other hand, most of the ship plying towards and away from Mongla Port area through the Sundarbans Reserve Forest area may be the prominent sources of air pollutants i.e. Particulate matters (PM<sub>2.5</sub>, PM<sub>10</sub> and SPM), Oxides of Sulphur (SO<sub>x</sub>), Oxides of Nitrogen (NO<sub>x</sub>) and Green House Gases (GHGs) in the forest area. On the other hand, engine boats and other motorized vehicles for fishing, honey collection, Golpata (Nipa palm) and timber collection, tourism business are also currently contributing in polluting in and around the Sundarbans reserve forest area. However, an inventory of the existing emission types and sources for the study area has been provided in **Table A2** of **Appendix IV**.

### 2.5 Monitoring locations

Current status of air quality was monitored at the same locations as monitored in the earlier quarterly programs. Moreover, the status of two additional locations were also included in the monitoring program considering the approval conditions recommended by DOE. The monitored locations for the air quality-monitoring program are shown in **Figure 2.2**. The details of the monitoring plan have been provided in **Table 2.1**.



Figure 2.1: Conducting Air Quality monitoring at Shapmari Area

Table 2.1: Air Quality Monitoring Plan

Sl. No.	Monitoring Indicators	Locations	GPS Points	Frequency	Methods/ Tools/ Techniques
1	Particulate Matter (PM <sub>2.5</sub> , PM <sub>10</sub> and SPM) SO <sub>x</sub> , NO <sub>x</sub> , CO and O <sub>3</sub> .	South West corner of the Project boundary	89°33'34.5"E; 22°34'33.8"N	Each Quarter of the year	Method of testing PM <sub>2.5</sub> : Gravimetric
2		Proposed township area near Chimney location, Mauza: Sapmari Katakhal.	89°32'3.8"E; 22°36'32.5"N		Method of testing PM <sub>10</sub> : USEPA (1997) Method 201 or 201A (as appropriate)
3		North West corner of the Project boundary (Kaigar Daskati)	89°33'51.8"E; 22°36'1.06"N		Method of testing SO <sub>x</sub> : USEPA (2000) Method 6 or 6A or 6B or ISO (1998)
4		Barni, Gaurambha union (4km North East from the chimney location)	89°34'37.7"E; 22°38'51.8"N		Method 11632 (as appropriate)
5		Chunkuri-2, Bajua Union (4km South West from the chimney location)	89°34'01.1"E; 22°32'3.3"N		Method of testing NO <sub>x</sub> : USEPA (2000) Method 7, 7A, 7B, 7C, 7D, or ISO (1993) Method 10396 (as appropriate).
6		Pankhali, Dacope, (4km North West from the Chimney location)	89°31'24.2"E; 22°36'6.7"N		
7		Mongla Port Area	89°35'50.4"E; 22°28'24.8"N		
8		Harbaria, Sundarbans	89°35'34.2"E; 22°17'43.1"N		
9		Akram point, Sundarbans	89°30'54.1"E; 22°23.50"N		
10		Hiron Point, Sundarbans	89°27'53.2"E; 21°46'27.60"N		
11		Khulna city near Khan Jahan Ali Bridge	89°35'35.5"E; 22°46'36.8"N		
12		Project site-1 (Proposed Township area)	89°33'13.7"E; 22°35'43"N		
13		Access road bridge area	89°35'16.49"E; 22°34'37.11"N		



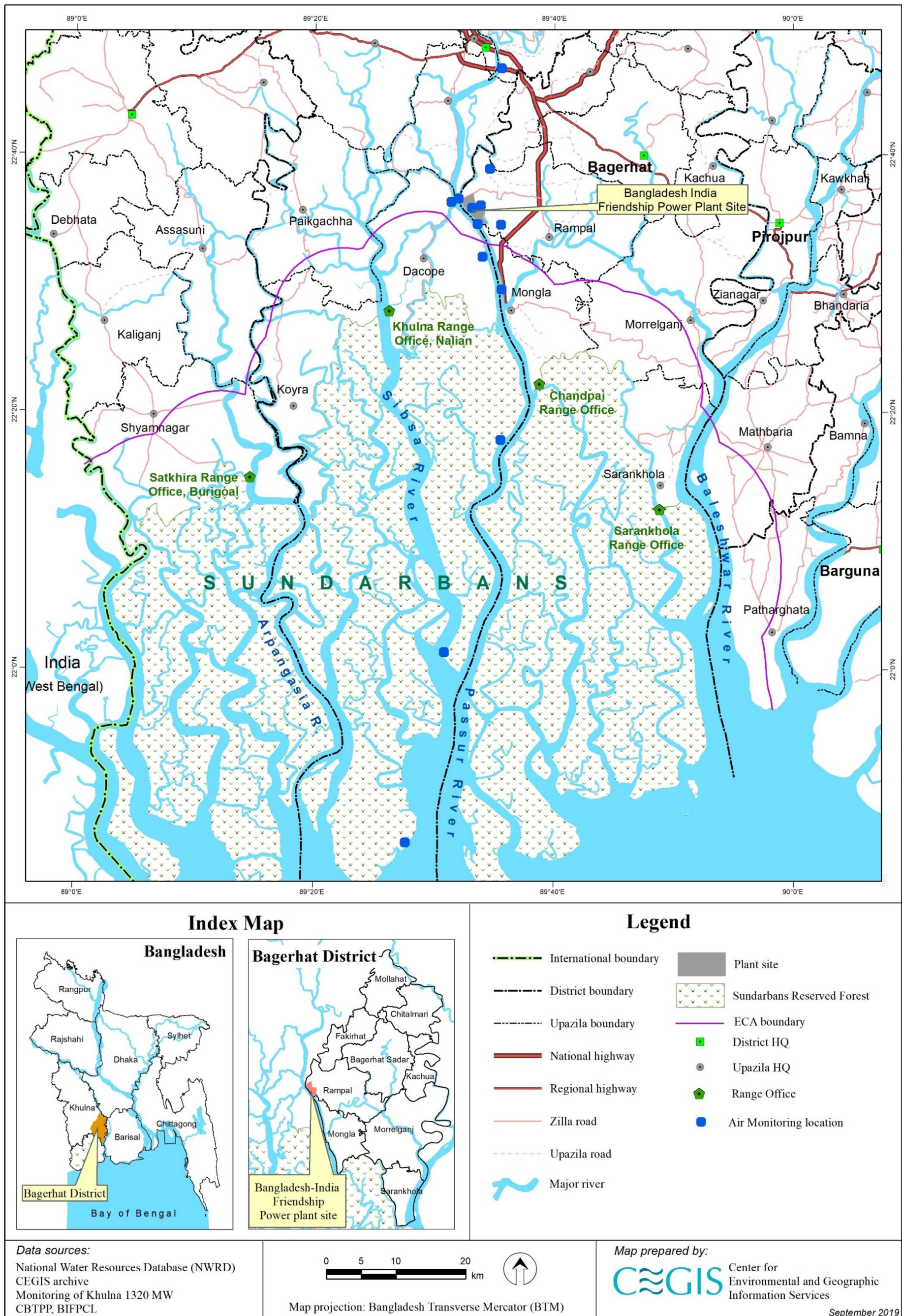


Figure 2.2: Air Quality Monitoring Locations







## 2.6 Status of air quality

Air quality is expressed in terms of the standards set forth for public health and welfare protection (against decreased visibility and damage to Human, animals, crops, vegetation etc.). The air pollution emission standards along with the current concentrations are listed in **Table 2.2**.

### *Particulate Matter ( $PM_{2.5}$ , $PM_{10}$ and SPM)*

The maximum value ( $51.32 \mu\text{g}/\text{m}^3$ ) of  $PM_{2.5}$  was found at Maidara Bridge area whereas the minimum value ( $14.65 \mu\text{g}/\text{m}^3$ ) was recorded at Power plant access road area. All values for the corresponding sites during this season were found well below the standard limit ( $65 \mu\text{g}/\text{m}^3$ ) set by ECR, 2005. On the other hand,  $PM_{10}$  concentration was found highest ( $127.65 \mu\text{g}/\text{m}^3$ ) at Maidara Bridge area and lowest ( $59.19 \mu\text{g}/\text{m}^3$ ) at Khan Jahan Ali Bridge area. Likewise, the results of  $PM_{10}$  for every location were found within the standard limit ( $150 \mu\text{g}/\text{m}^3$ ) too. However, the measured values were found higher than the previously monitored results in the same seasons. This might be due to the decreased rainfall and prevailing stormy wind in this season. From the measured values it can be mentioned that, effect of seasonal variations on the surrounding environment may be the main reason of increasing and decreasing of the concentration of the particulate matter in this area.

However, major sources of particulate matter generation in and around the project area as observed were the piling activities, soil contraction works, digging, tunneling and burrowing works, jetty erection activities, major construction works, dust from unpaved roads and vehicle movement, Construction materials and goods transportation and so on. Other sources of pollutants which may contribute to the existing pollution sources are the small industries like brick kilns, refineries, cement works, etc., diffuse sources like wood stoves, fires, and wind generated dust etc.

On the contrary, the concentration of SPM was found higher at Khan Jahan Ali Bridge area ( $183.56 \mu\text{g}/\text{m}^3$ ) whereas, the minimum concentration was observed at Khan Jahan Ali Bridge area ( $78.09 \mu\text{g}/\text{m}^3$ ) and the observed values were found within the standard limit. In this case, construction activities, land development works, wind erosion, large number of two-stroke human haulers, buses, trucks, and other anthropogenic activities were observed during the field visit, which might be the reason for such higher concentration of particulate matters in this area for the corresponding season (**Figure 2.3**). All the monitoring data have been attached in **Table A1** of **Appendix IV**.

Table 2.2: Air quality monitoring results (November, 2019)

Sl. No.	Location	PM <sub>2.5</sub> (µg/m <sup>3</sup> )		PM <sub>10</sub> (µg/m <sup>3</sup> )		SPM (µg/m <sup>3</sup> )		SO <sub>x</sub> (µg/m <sup>3</sup> )		NO <sub>x</sub> (µg/m <sup>3</sup> )		CO (mg/ m <sup>3</sup> )		O <sub>3</sub> (µg/m <sup>3</sup> )	
		Value	STD*	Value	STD*	Value	STD*	Value	STD*	Value	STD*	Value	STD*	Value	STD*
1	South West corner of the Project boundary (Maidara)	51.32	65	127.65	150	183.56	200	31.53	365	24.97	100	16	10	10	157
2	Proposed township area near Chimney location, Sapmari	19.34	65	82.27	150	120.45	200	60.26	365	58.39	100	11	10	22	157
3	North West corner of the Project boundary (Kaigar Daskati)	33.2	65	119.34	150	175.13	200	54.02	365	43.45	100	0	10	2	157
4	Barni, Gaurambha union (4km North East from the chimney location)	31.28	65	69.32	150	102.17	200	59.33	365	57.02	100	0	10	52	157
5	Chunkuri-2, Bajua Union (4km South West from the chimney location)	33.74	65	78.27	150	100.95	200	35.42	365	40.09	100	0	10	38	157
6	Pankhali, Dacope, (4km North West from the Chimney location)	24.03	65	119.28	150	147.29	200	44.29	365	17.72	100	0	10	26	157
7	Mongla Port Area	39.69	65	64.12	150	83.9	200	57.24	365	46.58	100	48	10	40	157
8	Harbaria, Sundarbans	36.66	65	91.1	150	123.5	200	59.41	365	51.09	100	18	10	12	157
9	Akram point, Sundarbans	36.67	65	87.15	150	122.62	200	35.23	365	31.26	100	24	10	90	157
10	Hiron Point, Sundarbans	27.76	65	67.89	150	90.31	200	45.81	365	44.92	100	2	10	16	157
11	Khulna city near Khan Jahan Ali Bridge	18.65	65	59.19	150	78.09	200	49.72	365	41.91	100	24	10	18	157
12	Project site-1 (Proposed Township area)	29.64	65	98.15	150	127.79	200	19.32	365	15.63	100	0	10	11	157
13	Access road bridge area	14.65	65	79.92	150	109.25	200	56.5	365	55.08	100	0	10	6	157

Source: CEGIS field survey

### *Sulfur-Dioxide (SO<sub>2</sub>)*

The concentration of Sulphur dioxide (SO<sub>2</sub>) in ambient air were found much lower than the Bangladesh standard limit of (365 µg/m<sup>3</sup>) at all the sampling locations. Among those, the maximum concentration (60.26 µg/m<sup>3</sup>) was found at Shapmari (North-east area of the project boundary) area while minimum concentration (19.32 µg/m<sup>3</sup>) was found at Township area of power plant. The values of SO<sub>2</sub> were never found to cross the standard value set in ECR' 2005. However, the average concentration of SO<sub>2</sub> have been found lower in post monsoon seasons than the Winter seasons. Emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc. are currently contributing to the concentration of SO<sub>2</sub> in this area (**Figure 2.3**) and the monitoring data have been attached in **Table A1** of **Appendix IV**.

### *Nitrogen Dioxide (NO<sub>2</sub>)*

The values of NO<sub>x</sub> in the Project site and its adjoining areas were observed below than the Bangladesh standard value of 100 µg/m<sup>3</sup>. The maximum concentration (58.39 µg/m<sup>3</sup>) during this monitoring period was found at Koigordashkatir Char area whereas the lowest (15.63 µg/m<sup>3</sup>) was recorded at Township area of power plant. The monitoring results are shown in **Table A1** of **Appendix IV**. However, emission from local human hauler, car, bus and industries like brickworks, refineries, cement works, iron and steel making, etc. are currently contributing to the concentration of NO<sub>x</sub> in this area (**Figure 2.3**) and the monitoring data have been attached in **Table A1** of **Appendix IV**.

### *Carbon Monoxide (CO)*

Carbon monoxide (CO) is generally produced due to the incomplete combustion of fossil fuel. The concentration of CO in the monitored locations were found much lower than the standard values set in ECR'2005. During the monitoring tier the maximum value of CO was measured (48 µg/m<sup>3</sup>) at Mongla area. The possible reasons for such CO concentration may be due to the movement of various types of vehicles across the Passur River and its adjoining areas (**Figure 2.3**) and the monitoring data have been attached in **Table A1** of **Appendix IV**.

### *Ozone (O<sub>3</sub>)*

Similarly, measured O<sub>3</sub> concentrations both in the Sundarbans Forest Area and Project area were found within a range of 52 µg/m<sup>3</sup> to 2 µg/m<sup>3</sup>, which are negligible comparing to the Bangladesh standards limits of 157 µg/m<sup>3</sup>. During the 22<sup>nd</sup> quarterly monitoring study, the maximum concentration (52 µg/m<sup>3</sup>) was found at Gaurambha area and the minimum value (2 µg/m<sup>3</sup>) was obtained at Koigordashkatir Char area (**Figure 2.3**) and the monitoring data have been attached in **Table A1** of **Appendix IV**.

Findings of the previously monitored data with seasonal variation has been appended in the following section-

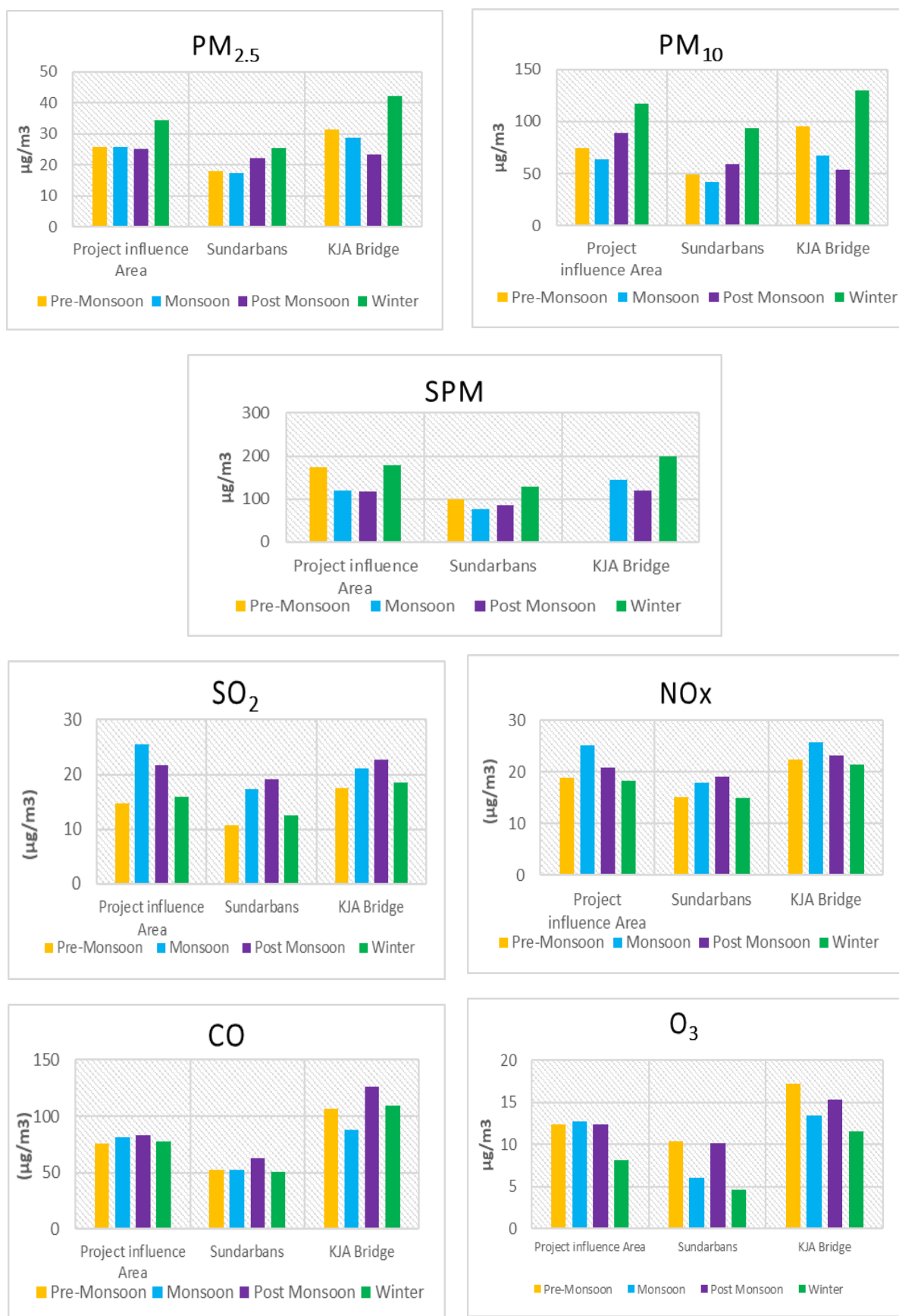


Figure 2.3: Seasonal variation of the Air Quality Parameters

### 2.6.1 Findings

During this tier, all the preselected parameters were measured at all the preselected locations. All the measured values of all parameters for all locations were found well below the standard limit set by ECR' 2005. No significant changes were observed among the concentrations of air pollutants for each location. But due to the less precipitation during the monitoring period, the concentration of the major air pollutants was found comparatively higher than the previously monitored data of the same seasons. It can also be noted that, the concentrations of major air pollutants were found comparatively lower in Sundarbans area than the other monitored area. However, according to the measured values it can be easily said that, the present air shed is not a degraded airshed as no significant exceedances or variation has ever been recorded among the concentrations of criteria pollutants.

## 2.7 Noise Quality

Among the sources of noise generation, the urban and rural vehicles i.e. buses, trucks, local human haulers, auto-rickshaws, motorized vans, motorbikes etc. were much noticeable in the study area. On the other hand, engine boats, trawlers, small barges, ships plying over the waterways and the wave breaking sound were found during this monitoring season (**22<sup>nd</sup> monitoring** program). Generally, the level of noise is monitored at eleven locations during every monitoring season. In this season, each of the locations was monitored.

### 2.7.1 Methodology

Noise levels were measured thrice in a day (morning, afternoon and evening) at ten (10) locations in and around the project area and inside the Sundarbans forest area. Each time, noise levels were recorded using sound level meter for five minutes of time span with an interval period of 30 second and the noise meter was properly set up and calibrated following the instruction manual. On the other hand, the monitoring locations were selected considering the sensitivity of the nearest receptors and accordingly, 6 (six) sites were selected in and around the Project area, 3 (three) sites were designated inside the Sundarbans Reserve Forest Area, 1 (one) at Mongla Ghat area and the remaining 1 (one) was selected at the Khan Jahan Ali Bridge toll plaza area (**Figure 2.4**).



**Figure 2.4: Ambient Noise Acquisition in Harbaria, Sundarbans**



### 2.7.2 Locations of Noise Level Monitoring

Out of eleven (11) locations, three locations were inside the Sundarbans, six locations were in and around the Project site, one was at Khan Jahan Ali Bridge on Rupsha River and the remaining one was at Mongla Port area. The monitoring plan of noise level is presented in the following **Table 2.3**

**Table 2.3: Noise Monitoring Plan**

SL. No.	Monitoring locations	GPS points	Time of noise monitoring
1	South West corner of the Project boundary	89°33'34.5"E; 22°34'33.8"N	Morning, Noon and evening
2	Proposed township area near Chimney location, Mauza: Sapmari Katakhal	89°32'3.8"E; 22°36'32.5"N	Morning, Noon and evening
3	North West corner of the Project boundary (Kaigar Daskati)	89°33'51.8"E; 22°36'1.06"N	Morning, Noon and evening
4	Barni, Gaurambha union (4km North East from the chimney location)	89°34'37.7"E; 22°38'51.8"N	Morning, Noon and evening
5	Chunkuri-2, Bajua Union (4km South West from the chimney location)	89°34'01.1"E; 22°32'3.3"N	Morning, Noon and evening
6	Pankhali, Dacope, (4km North West from the Chimney location)	89°31'24.2"E; 22°36'6.7"N	Morning, Noon and evening
7	Mongla Port Area	89°35'50.4"E; 22°28'24.8"N	Morning, Noon and evening
8	Harbaria, Sundarbans	89°35'34.2"E; 22°17'43.1"N	Morning and Noon
9	Akram point, Sundarbans	89°30'54.1"E; 22°23.50"N	Morning and Noon
10	Hiron Point, Sundarbans	89°27'53.2"E; 21°46'27.60"N	Not monitored
11	Khulna city near Khan Jahan Ali Bridge	89°35'35.5"E; 22°46'36.8"N	Morning, Noon and evening
12	Township area of ppower		

### 2.7.3 Status of Noise

In order to provide an overview of the observed data set the average values for the respective locations have been appended in **Table 2.4** for ready reference; but the detailed Noise Level All associated data are attached in **Table C1, C2, C3, C4, C5 and C6** respectively in the **Appendix IV**.

#### *Dacope Upazila Parishad*

This monitoring location is a commercial area and located at a distance of 4 km in the North West direction of the proposed Chimney location. According to the Noise Pollution Control Rules (2006), noise level standard for this area at day time is 70 dB and the level of noise was recorded as 58.60 dB (A) in this monitoring season which is 11.40 dB (A) lower than that of Bangladesh standard limit (70 dB) (**Table 2.4**). The significant noise sources at this place were found as the road traffics, engine operated van (locally called Nosimon), motor bikes, easy bikes (battery operated tri-cycle), hat/bazar etc.

*North West Corner of the Project Area (Kaigar Daskati)*

The North West (NW) corner of the Project site is under the Kaigar Daskati mauza of Gaurambha union. The selected monitoring site is situated at the Gucchha gram (a cluster village) and can be characterized as a residential area for the resettled people. However, the standard value for this area is 55 dB (A) at day time (Noise Pollution Control Rules, 2006). The average day time noise level during this monitoring period was recorded as 51.11 dB (A) which was 3.89 dB (A) higher than that of Bangladesh standard limit.

*Chunkuri-2, Bajua*

This area is located at 4km South West direction from the chimney location. This site is a residential area and the standard has been set as 55 dB (A) at day time (Noise control rule, 2006). During this monitoring period, the noise level was found to be 55.27 dB (A) which was 0.27 dB (A) higher than that of Bangladesh standard limit. However, the observed noise sources were rural crowd, noise from river side homesteads etc.

*South West corner of the Project area*

The South West corner of the Project area is in Maidara Khal of Rajnagar union. This area is a residential area and the standard limit of noise is 55 dB at day time (ECR, 1997). The level of noise at this monitoring location in this season was found to be 46.57 dB (A) which was 8.43 dB (A) lower than that of Bangladesh standard limit. Frequent movement of water vessels over the Moidara Khal was one of the main reasons of noise generation.

*Shapmari Area (North-east corner of the project boundary)*

The proposed township area of the Power Plant is located at the northeast portion of the Project area. The prominent noise sources were the construction activities and some discrete local gathering from the surrounding homesteads. This is a residential area and the standard has been set as 55 dB (A) at daytime (Noise control rule, 2006). The level of sound during this monitoring period was recorded as 54.88 dB (A) in this site which was 0.12 dB (A) lower than that of standard limit.

*Barni, Gaurambha*

This area can be characterized as both the residential and commercial interests and the standard noise limit for this kind of mixed zone is 60 dB (A) at day time. The noise level was found as 50.53 dB (A) during this monitoring season which is 9.47 dB (A) lower than the standard value.

*Khan Jahan Ali Bridge, Khulna*

This is a commercial zone. The monitoring site is occupied by the toll office of Khan Jahan Ali Bridge, agricultural farms and local tourism spots. The average noise level was found as 66.05 dB (A). The highway traffic was found to be the main source of noise generation. Besides, the site attracts local visitors for its scenic beauty which also creates a significant source of noise pollution in this area.

*Mongla ghat area*

This area is heavily occupied with the industrial set up and the corresponding standard value for the industrial area is 75 dB (A) for the day time. During this period, the average day time noise level at this location was observed as 57.25 dB (A) which was 17.75 dB (A) lower than

that of Bangladesh standard value. The sources of noise were mostly road traffic (heavy vehicles, light vehicles, etc.), noise from Mongla Port activities (crane, ships, etc.) and local mob in the Ghat area.

#### *Harbaria, Sundarbans*

Harbaria area of the Sundarbans is considered as a hot spot of biodiversity and an important anchoring site for most of the large ships. Most of the sea going vessels used to anchor at this site for transshipment of goods and commodities. The area is under the silent zone and the standard limit of ambient noise at daytime is 50 dB (Noise pollution control rules, 2006). The noise level was measured at a distance of 100 m (Inside the forest area) from the River bank and found as 44.10 dB (A) during this monitoring period which was 5.90 dB (A) lower than that of standard limit. However, movement of ships, sound created by running engines of anchored ships and barges, transshipment activities, bird's chirping, wave breaking sound and wind action on tree leaves were observed to be the main sources of noise in this site.

#### *Akram point, Sundarbans*

Akram Point of the Sundarbans is another biodiversity hot spot in the Sundarbans. This area is under the silent zone and the ambient daytime noise standard is 50 dB (A). In this monitoring season, noise level was recorded at a distance of 100 m (Inside the forest area) from the River bank. The average day time ambient noise level during this monitoring season was observed as 44.86 dB (A) which was 5.14 dB (A) lower than that of Bangladesh standard value. However, Birds' chirping, stormy wind, wave breaking sound and falling of leaves from the trees were found as the main sources of noise.

#### *Hiron point, Sundarbans*

This noise sampling location falls under the demarcated area of World Heritage Site. Noise level is measured at the western bank of Passur river mouth and eastern side of the Sundarbans South Sanctuary. This location is highly important as the Mother vessels enter into the Passur river adjacent to this point and the river is roughly 5-6 km wide between two banks at the confluence point.

However, the noise level was found as 40.28 dB (A) during this monitoring season which was 9.72 dB (A) lower than the standard value. This area is also under the silent zone where the ambient day time noise standard is 50 dB (A). Sound of sea shore, wind blow, creeping of birds and small mechanized sea going boat might be responsible for the present noise level



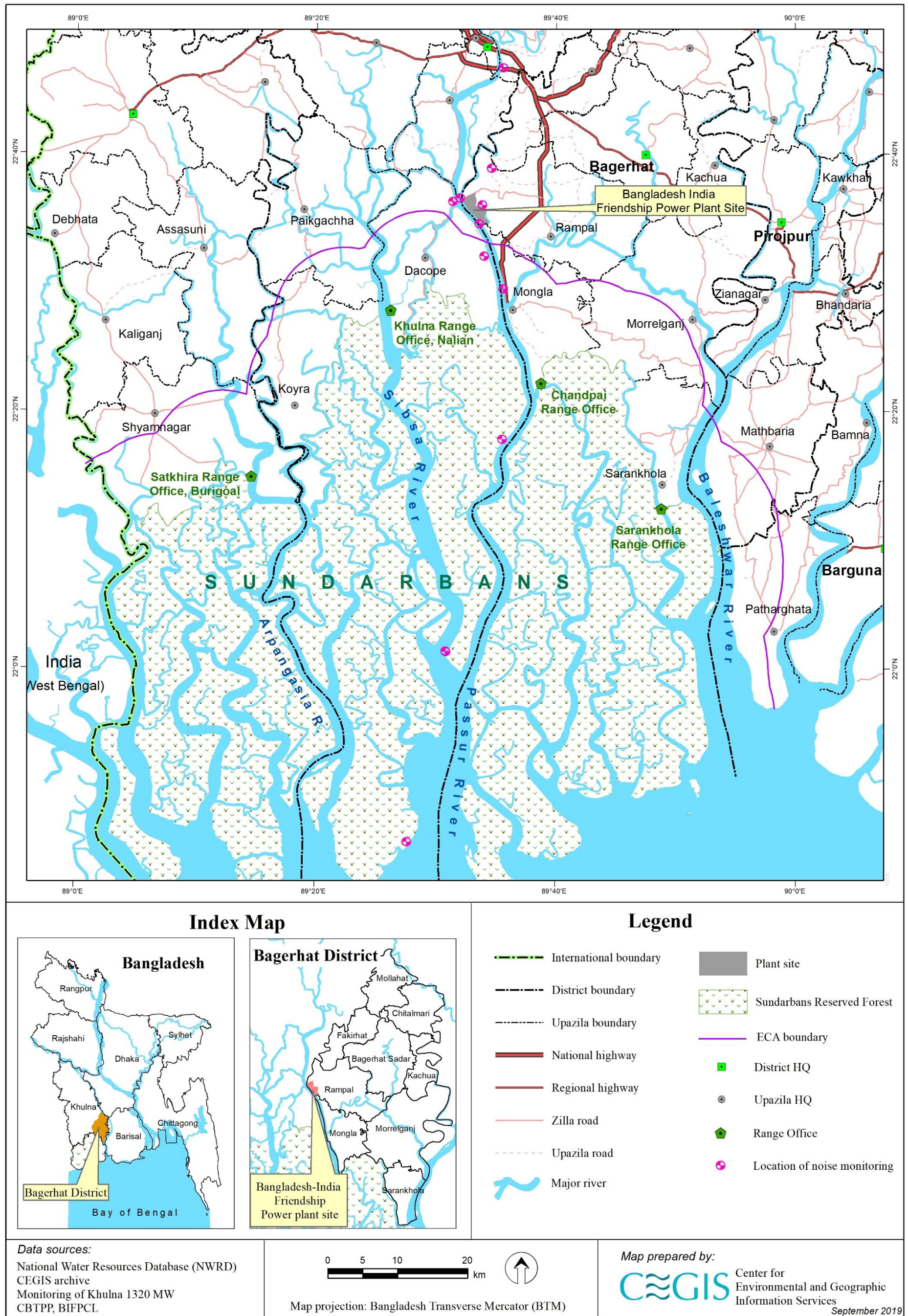


Figure 2.5: Noise Level Monitoring Locations





Table 2.4: Summary of the ambient noise levels recorded in consecutive monitoring periods

Sl.	Location	Monitoring periods																						
		QM 1 (Apr-14)	QM 2(Jul-14)	QM 3 (Oct-14)	QM 4 (Jan-15)	QM 5 (Apr-15)	QM 6 (Jul-15)	QM 7 (Oct-15)	QM 8 (Jan-16)	QM 9 (Apr-16)	QM 10 (Jul-16)	QM 11 (Oct-16)	QM-12 (Jan-17)	QM-13 (Apr-17)	QM-14 (Oct-17)	QM-15 (Jan-18)	QM-16 (Apr-18)	QM-17 (Jul-18)	QM-18 (Nov-18)	QM-19 (Feb-19)	QM-20 (Apr-19)	QM-21 (Jul-19)	QM-22 (Nov-19)	Std*
1	Chalna, Dacope	68.13	52.87	54.63	53.28	57.08	49.77	65.12	66.07	65.08	52.42	65.51	59.29	61.62	58.64	60.1	59.63	57.54	58.23	56.45	61.67	59.34	58.60	70
2	NW Corner of the Project area (Kaigar Daskati)	51.89	NM	41.92	35.25	44.67	41.56	41.94	50.96	50.79	52.65	55.48	44.52	47.19	46.95	49.3	47.90	45.63	58.82	50.75	56.85	55.18	51.11	55
3	Chunkuri-2, Bajua	57.76	52.55	51.39	49.29	47.05	40.66	47.43	53.62	44.49	53.4	51.55	55.31	50.44	50.44	51.4	52.93	47.54	48.69	50.18	51.68	59.36	55.27	55
4	SW corner of the project area (Moidara)	49.2	47.6	45.95	36.03	43.58	43.75	42.7	60.44	54.50	65.37	48.51	45.19	43.25	43.26	44.5	47.55	52.63	61.78	55.79	56.05	63.66	46.57	55
5	Proposed Township area (Shapmari)	48.75	46.68	41.92	41.47	41.47	46.75	50.52	53.77	53.37	55.79	43.69	42.62	42.65	43.93	53.3	50.81	44.25	50.68	58.13	58.83	54.53	54.88	55
6	Barni, Gaurambha	58.84	49.95	49.78	43.6	54.17	46.18	55.16	59.16	53.97	56.75	54.91	49.05	44.83	45.52	55.6	56.14	45.52	53.03	52.57	53.18	54.67	50.53	60
7	Khan Jahan Ali Bridge, Khulna	71.7	60.8	66.28	61.72	73.45	52.82	64.25	68.45	65.85	63.77	60.95	55.57	56.72	62.47	61.7	64.87	63.36	62.15	66.93	66.95	63.46	66.05	70
8	Mongla Port area	61.24	53.84	60.5	38.69	48.15	39.61	47.01	52.7	49.88	52.86	49.86	48.95	47.61	49.66	59.8	62.95	60.97	55.97	66.18	63.99	62.01	57.25	75
9	Harbaria, Sundarbans	40.88	56.13	55.3	34.38	65.37	35.03	50.75	45.2	44.55	52.9	55.33	41.18	54.10	46.48	44.4	47.93	50.28	48.80	49.67	48.43	44.90	44.10	50
10	Akram Point, Sundarbans	40.94	47.9	43.98	34.32	54.86	NM	49.6	42.95	42.95	47.96	41.77	38.08	44.30	42.38	40.1	45.39	45.20	41.00	46.45	42.33	44.84	44.86	50
11	Hiron Point, Sundarbans	38.63	51.29	47.98	37.37	47.84	NM	46.06	NM	43.11	NM	44.38	42.29	NM	39.79	38.8	NM	NM	39.4	39.21	NM	NM	40.28	50

Note: All values are in decibels (dBA), QM- Quarter Monitoring, NM – Not Monitored, \*Std- Standard as defined in National Noise Control Rules, 2006

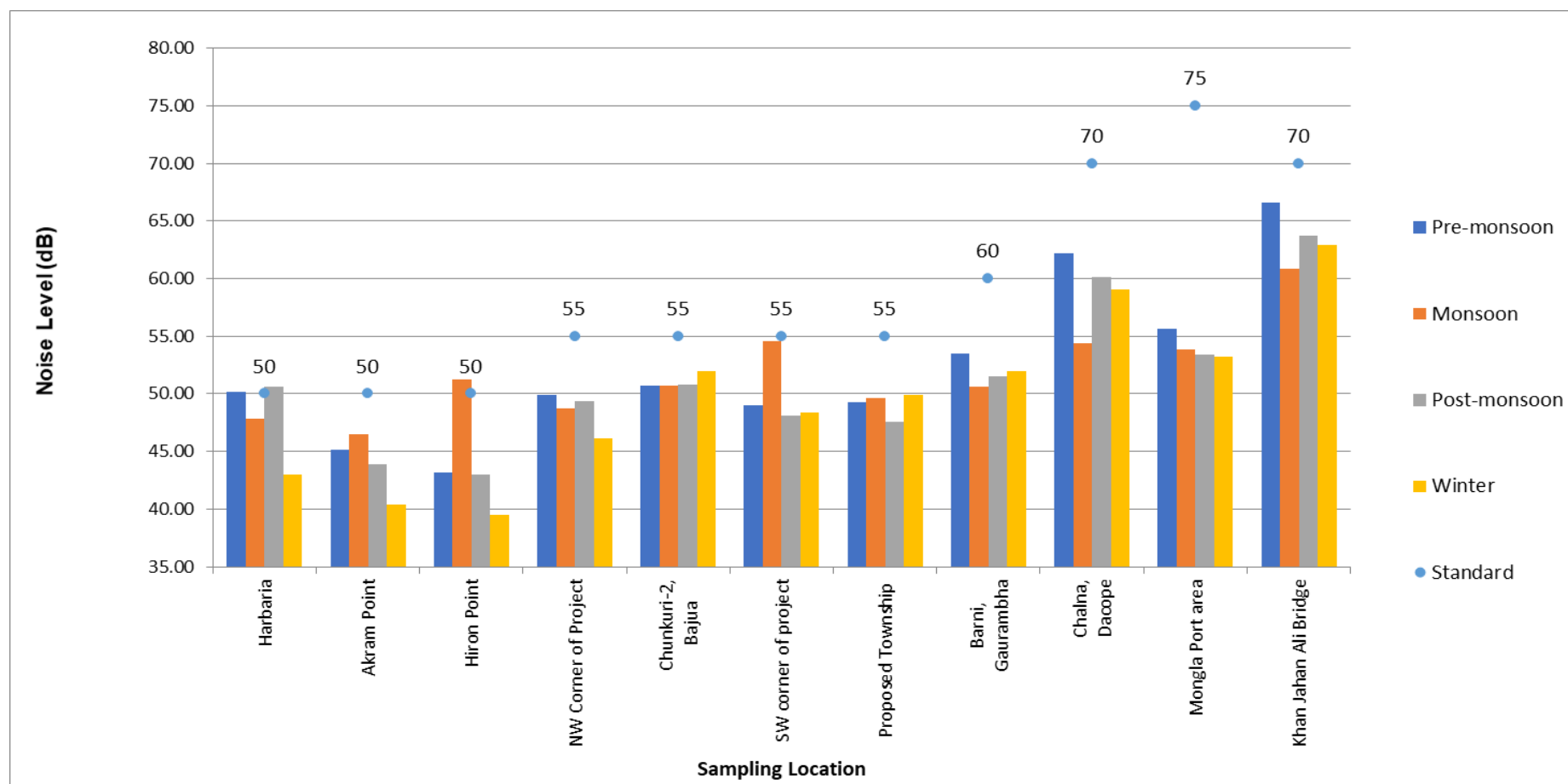


Figure 2.6: Status of Noise level at the monitoring locations

### 2.7.4 Findings

The noise generation sources in the study area can mainly be divided into two types; one is natural and the other one is anthropogenic. Natural sources of noise generation were birds' chirping, stormy wind, wave breaking on the shoreline, howling of leaves and so on. On the other hand, traffic mobilization, industrial activities, vessels movement within the rivers and local vehicles were the anthropogenic sources of noise. However, the observed noise level was not found to exceed the Bangladesh standard limit of noise level at ten locations during this monitoring (22<sup>nd</sup> quarter) season (Table 2.4). On the other hand, the observed noise level at Chunkuri-2 (Bajua) located at 4km South West direction from the chimney location was found to exceed the Bangladesh standard limit of standard values. In course of the total twenty-two monitoring seasons, the noise level of eight locations were found to exceed the Bangladesh standard limit of their corresponding standard values in their different monitoring seasons.

## 2.8 Water Quality

An updated water quality status of the Passur-Sibsa River system and adjacent water bodies have been depicted in this section. The methodologies used for the entire monitoring activities, both the national and international guidelines were followed and adopted. This report includes physical water quality parameters collected during 22<sup>nd</sup> quarterly monitoring (October, 2019) and the tested results obtained from the laboratory up to July 2019 (21<sup>st</sup> quarterly monitoring). The surface and groundwater quality were monitored in the respective locations performed during the previous monitoring. A number of identical parameters were selected to understand the quality of the water for community use, aquatic life, and for the Sundarbans Forest ecosystem itself.

### 2.8.1 Methodology

Water quality monitoring covers selection of water quality parameters, identification of sampling locations, determination of sampling frequency and evaluation criteria of the monitoring parameters etc. Standard approaches and methodologies were followed for the above-mentioned events. Both the surface and groundwater quality statuses in and around the Power Plant and the Sundarbans area were examined. The monitoring results have been presented graphically and been compared with the national standards (ECR, 1997 and all available amendments).

The samples were collected from eighteen (18) pre-selected locations (15 locations for surface water along the Passur River, Sibsa River, Maidhara River, near the proposed township area, and 3 locations for groundwater around the study area). The selected monitoring locations for the current monitoring program are shown in **Figure 2.7**. The details of the monitoring plan covering sampling locations, geographical locations, frequency and analysis techniques of sampling for surface and groundwater are given in **Table 2.5** and **Table 2.6** respectively.





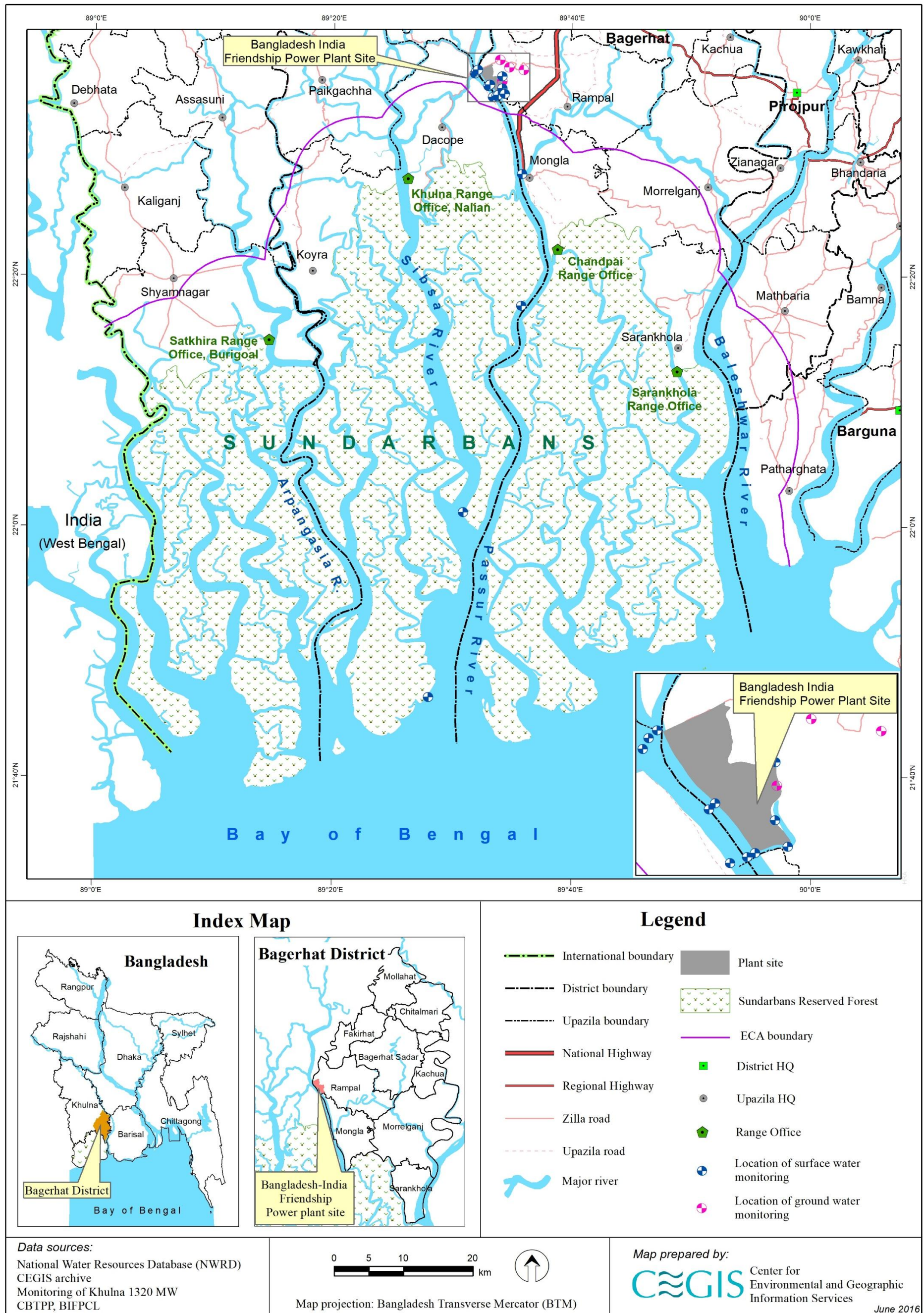


Figure 2.7: Surface water and Groundwater Quality Monitoring Locations







**Table 2.5: Surface Water Quality Monitoring Parameters, Locations and Plan**

Sl no	Monitoring Indicators	Locations	GPS (Decimal Degree)		Frequency	Methods/Tools/ Techniques
			Easting	Northing		
1	pH, Temperature, Salinity, DO, BOD <sub>5</sub> , TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease	Left Bank of Passur River at 100m u/s of North West corner of the Project boundary	22.604167°N	89.527222°E	Quarterly	In-situ measurement (pH, Temperature, Salinity, DO) and Laboratory analysis (TDS, TH, TSS, COD, Nitrate, Sulphate, Phosphate, Arsenic, Lead, Mercury, Oil & Grease). BOD <sub>5</sub> were measured for an interval period of 5 days.
2		Middle of Passur River at 100m u/s of North West corner of the Project boundary	22.607222°N	89.528889°E		
3		Right Bank of Passur River at 100m u/s of North West corner of the Project boundary	22.609361°N	89.531417°E		
4		Left Bank of Passur River at Project Site-Jetty	22.584833°N	89.543583°E		
5		Middle of Passur River at Project Site-Jetty	22.587667°N	89.546472°E		
6		Right Bank of Passur River at Project Site-Jetty	22.589333°N	89.548222°E		
7		Left Bank of Passur River at South West corner of the Project boundary	22.572889°N	89.552583°E		
8		Middle of Passur River at South West corner of the Project boundary	22.574611°N	89.557500°E		
9		Right Bank of Passur River at South West corner of the Project boundary	22.575667°N	89.559861°E		
10		Maidara river at the South East corner of the project boundary at Ichamoti-Maidara confluence	22.600639°N	89.565611°E		
11		Maidara river near proposed Township area	22.577472°N	89.569250°E		
12		Passur river at Passur – Ghasiakhali confluence	22.473861°N	89.602361°E		
13		Passur river at Harbaria of the Sundarbans Reserve Forest area	22.295250°N	89.593139°E		
14		Passur river at Akram Point of the Sundarbans Reserve Forest area	22.024120° N	89.514220°E		
15		Passur river at Hiron point of the Sundarbans Reserve Forest area	21.774183°N	89.464778°E		

**Table 2.6: Groundwater Quality Monitoring Parameters, Locations and Plan**

SI No	Locations	GPS (Decimal Degree)		Frequency	Methods/Monitoring indicators/ Techniques
		Easting	Northing		
1	Near Proposed Township Area	89.566139°E	22.594167°N	Quarterly	In-situ testing of physical water quality parameters by Horiba U-50 multi-meter. Sample preserving and Laboratory analysis at DPHE Central Laboratory and BCSIR for inorganic non-metallic, aggregate organic and metals quality. However, one of the monitoring location (Kalekarber) has been found damaged since 2015. Hence, the corresponding data for this location were not collected.
2	Rajnagar	89.576056°E	22.612528°N		
3	Kapasdanga	89.563000°E	22.622528°N		

### **2.8.2 Selection of Parameters**

Water quality parameters were selected based on tentative potential impacts to be generated during pre-construction, construction and operation phases of the Power Plant Project.

### **2.8.3 Surface Water Quality Parameters**

The selected parameters for surface water quality include Temperature, pH, Dissolved Oxygen (DO), Total Dissolve Solids (TDS), Total Suspended Solids (TSS), Total Hardness (TH), Turbidity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Salinity, Nitrate ( $\text{NO}_3^-$ ), Phosphate ( $\text{PO}_4^{3-}$ ), Sulphate ( $\text{SO}_4^{2-}$ ), Heavy Metals (As, Pb, Hg), and Oil and Grease. The parameters were categorized into 4 groups:

- Physical and aggregate properties i.e. pH, Temperature, Salinity, Hardness, TDS, TSS, Turbidity, Oil & Grease;
- Inorganic non-metallic constituents i.e., DO,  $\text{NO}_3^-$ ,  $\text{PO}_4^{3-}$  and  $\text{SO}_4^{2-}$ ;
- Aggregate organic constituents i.e. BOD, COD;
- Heavy metals i.e. As, Pb and Hg;

However, some additional parameters i.e. PAH (Polynuclear Aromatic Hydrocarbons), TOC (Total Organic Carbon) and TC (Total Carbon) were included in the monitoring study as per recommendation of the DOE approved coal transportation study monitoring framework. The analyzed data of the additional parameters will be recorded and submitted to the DoE and other concerned authorities as per the condition no. 26 of the EIA approval of coal transportation study. Nevertheless, all the analyzed data will be incorporated and discussed in the next monitoring report after obtaining the analyzed results from the respective organizations.

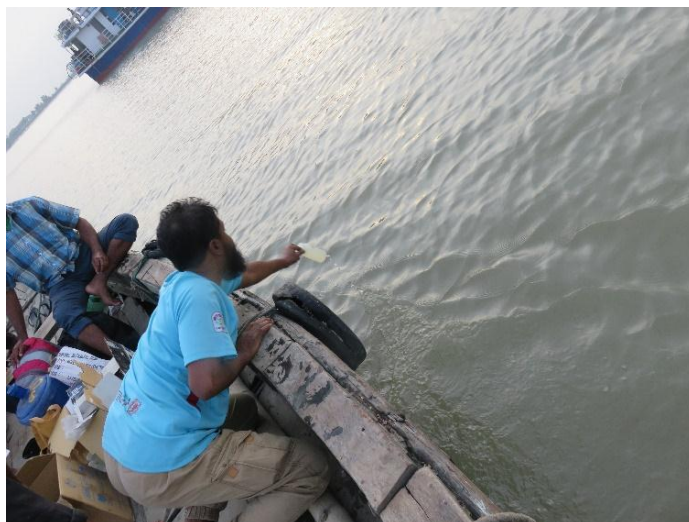
### **2.8.4 Groundwater Quality Parameters**

Ground water quality parameters include pH, Temperature, Dissolved Oxygen (DO), Total Dissolve Solids (TDS), Total Hardness (TH), Chemical Oxygen Demand (COD), Salinity, Nitrate ( $\text{NO}_3^-$ ), Phosphate ( $\text{PO}_4^{3-}$ ), Sulphate ( $\text{SO}_4^{2-}$ ), and Heavy Metals (As, Pb, Hg).

### **2.8.5 Sampling Procedure**

The standard sampling procedure was followed for both surface and groundwater sampling to reduce the possibility of any error. Each sample was labelled at the time of sampling

### 2.8.6 Surface Water Sampling Procedure



**Figure 2.8: Surface water collection from Harbaria of Sundarbans**

The study area is highly influenced by tidal variation. Hence, temporal and spatial variations of tides were considered in sampling procedure. Surface water samples were collected at a distance of 30-50m away from the riverbank and at a depth of 6 cm below the water surface during low tides or relative slack period after the low tide for all parameters except oil and grease. The non-acidified sampling bottles were rinsed with respective water samples before sampling and storing below 10°C. Acidified sampling bottles were used for heavy metal (As, Pb, Hg) sample collection. All samples were preserved as per standard procedure.

### 2.8.7 Groundwater Sampling Procedure

The groundwater samples were collected from hand operated tube wells after 5-7 minutes of water extraction. Each sampling bottle was rinsed with respective water samples before sample collection and storing. Acidified sampling bottles were used for heavy metals (As, Pb, Hg) sample collection and were preserved following standard procedure.

### 2.8.8 Water Quality Parameter Analysis Techniques/Methods

Water quality parameters were analyzed as per the procedure of American Public Health Association (APHA) standard. The analysis procedures of different parameters along with the standards are given in **Table 2.7**.

**Table 2.7: Testing Methodology of Water Quality Parameter**

Parameters	Methods/Measuring Tools	Unit	BD Standard (ECR 1997)
Temperature	Horiba U-50 multimeter	°C	20 - 30
pH	Horiba U-50 multimeter	-	6.5-8.5
TDS	Horiba U-50 multimeter	ppm or mg/L	2100 (SW), 1000 (GW)
TSS	Horiba U-50 multimeter	ppm or mg/L	150 (SW), 10 (GW)
Salinity	Horiba U-50 multimeter	ppt	-
DO	Horiba U-50 multimeter	ppm or mg/L	6
BOD <sub>5</sub>	5-Day BOD Test at 20°C	ppm or mg/L	50 (SW)
COD	Closed Reflux Method	ppm or mg/L	200 (SW), 4.0 (GW)
Total Hardness (as CaCO <sub>3</sub> )	Titrimetric	ppm or mg/L	200-500
Ortho-Phosphate (PO <sub>4</sub> <sup>3-</sup> )	UV-VIS Spectrophotometers	ppm or mg/L	6
Nitrate (NO <sub>3</sub> <sup>-</sup> )	UV-VIS Spectrophotometers	ppm or mg/L	10
Sulphate (SO <sub>4</sub> <sup>2-</sup> )	UV-VIS Spectrophotometers	ppm or mg/L	400
Oil and Grease	Liquid-liquid extraction with hexane, treatment with silica gel and gravimetric determination	ppm or mg/L	10 (SW)
Arsenic (As)	Atomic Absorption Spectrophotometers–Hydride Vapor Generating (AAS-HVG)	ppm or mg/L	0.05
Lead (Pb)	Atomic Absorption Spectrophotometers–Graphite Furnace (AAS-GF)	ppm or mg/L	0.05
Mercury (Hg)	Mercury Analyzer	ppm or mg/L	0.001

BOD<sub>5</sub> could not be tested in the laboratory as transportation time of samples for BOD<sub>5</sub> test is only 6 hrs and the sampling locations are within the Sundarbans Reserve Forest area from where it requires several days to carry the sample to the nearest laboratory i.e. at Khulna. Hence, water samples were kept in specified bottles (wrinkled paper water bottles) for 5 days for natural incubation. The difference of 5 day's DO and initial DO was considered as BOD<sub>5</sub>. Samples of other preselected parameters were preserved and analyzed in the laboratory.

### **2.8.9 Water Quality Reporting Arrangement**

Water quality status of the adjacent water bodies of power plants and the Sundarbans deep forests are being observed since April 2014. In this 20<sup>th</sup> quarterly water quality monitoring report, yearly variations of winter (January, 2019) for chemical water quality statuses and yearly variations in pre-monsoon (April 2019) for physical water quality statuses are presented and compared with the ECR' 1997 Standards. To do so, all sampling points are clustered in five different sampling sites considering homogenous characteristics of the sampling points as well as the type of ecosystem touching the sample points. The clustered sample monitoring sites and the logical explanation of the clusters are presented in the following **Table 2.8**.

**Table 2.8: Monitoring sites and characteristics.**

SL	Monitoring sites	Site Characteristics
(a)	Power plant & adjacent areas	In this monitoring site, total 11 sampling points have been averaged to represent the water quality status of power plant and its adjacent surface water bodies. These 11 sampling points are situated in the same river system and embedded within 1km radius of power plant. In addition, previous monitoring results indicated same water chemistry. Therefore, this study makes the clusters to represent the water quality status of the areas in a more explainable and understandable way.
(b)	Mongla-Passur confluence	This monitoring site comprises with an individual monitoring point situated at least 13km downstream of the power plant. This point is a confluence of Passur river and Mongla-Ghasiakhali channel. The terrestrial ecosystem is mostly dominated by agricultural lands followed by rural settlements.
(c)	Harbaria	Harbaria site comprises with an individual monitoring point situated around 15 km downstream of the Mongla-Passur confluence. This site is dominated by Sundarbans Forest. Heavy activities of mother vessels unloading and small cargo movement for carrying of clinker, coal and LPG gas. Influenced by tidal effects of Bay of Bengal.
(d)	Akram point	Akram point is an individual point, which is, located around 35 km downstream of the Harbaria point. This site is situated on the bank of Sibsa river before mixing with Passur river at Sibsa point. This site is completely dominated by deep forests ecosystems. Influenced by tidal effects of Bay of Bengal.
(e)	Hiron Point	Hiron point is the farthest point of this surface water-monitoring scheme. This point is at 25 km downstream of the Akram point. Deep forests and marine habitats are the main characteristics of the site. This site is completely exposed to Bay of Bengal. This site is also an individual monitoring point.

### *Status of Surface Water Quality*

#### In-situ tested parameters

The in-situ tested results obtained up to 22<sup>nd</sup> monitoring period (October 2019: Post-monsoon Season) are described below and the legend identification of different monitoring periods has been shown in **Figure 2.9**.

#### pH

Twenty second (22<sup>nd</sup>) quarterly monitoring was held in the month of October 2019, usually called the Post-monsoon season of Bangladesh. During that visit, pH values in the monitoring sites were found to range between 7.2 and 8.0. The lowest pH value was found in the Middle and Right of Passur River at South West corner from the Project boundary whilst highest was at Passur River at Passur-Mongla confluence and Harbaria. The last monitoring season showed consistency to all the other post-monsoon monitoring seasons (**Table B.1: Appendix-IV**).

Altogether, pH value was 7.5 near the power plant areas and 8.0 Mongla Passur Confluence. However, until now, pH value did not violate the ECR' 1997 Standard yet (6.5-8.5 inland water; SCHEDULE-3 and 6-9 for project waste disposal; SCHEDULE-10).

During post monsoon and winter season, river flow and water level normally reduced due to inadequate rainfall and insufficient inflow from U/S (upstream) of Passur-Sibsa RS (River System). As a result, pH values increased than those of the pre-monsoon and monsoon

seasons, which has also reported by others (Rahman et al., 2013). In addition to that, post-monsoon shows a little bit lower pH value than the winter season, as during post-monsoon there is some rains at August while in January it is normally zero.

Fluctuations in pH values during different season of the year can be attributed to factors like; removal of CO<sub>2</sub> by photosynthesis through bicarbonate degradation, dilution of waste with freshwater, reduction in salinity and temperature, and decomposition of organic matter (Rajasegar, 2003).

Seasonal variations in pH concentrations among the selected monitoring sites during the quarterly monitoring programs of first, second, third, fourth, fifth and sixth year of Passur-Sibsa RS are presented in **Figure 2.10** and the observed dataset are attached in **Table B.1 of Appendix- IV**.

### Temperature

Comparatively low surface water temperature was recorded in the last monitoring season (post-monsoon) than the other monitoring period in all the observed sites (**Figure 2.11**). All the points of South West corner from the project boundary and Maidara river showed the lowest temperature (27°C) while high temperature was observed at the Hiron point (31°C). According to the ECR, 1997; 30°C water temperature is still be tolerable by the aquatic organisms in tropical environment. All of the monitoring sites showed 10°C temperature variation except Hiron point. High saline prone areas (deep mangrove forest including Hiron point) may increase the temperature a bit due to its high electrical conductivity comes from various ions of salts (Salt of Na, K, I, Mg etc.). It can be concluded that, construction works does not influence water temperature until to date.

The surface water temperature largely depends on daily weather condition (Bartram J et al., 1996). According to the seasonal weather pattern of Bangladesh the temperature drops to a minimum level during winter, which is also applicable for the water temperature and thus it differs largely than the other season's temperatures. Recorded temperatures indicated that there was spatial variation among the monitoring sites even in the same season.

The measured temperature in the selected sites during the quarterly monitoring programs of first, second, third, fourth, fifth and sixth year are presented in **Figure 2.11** and all the observed dataset are attached in **Table B.2 of Appendix- IV**.

### Salinity

The observed salinity concentration ranged between 0.1ppt and 9.2ppt during the post-monsoon period. However, there was some spatial variations in salinity concentration of Passur-Sibsa River System. The maximum salinity was observed at Hiron point in the Sundarbans while minimum in the Maidara River. The highest salinity at the Hiron point was because of complete seawater influence. Besides, in all the sampling locations close to the project site the salinity range was found 0.2-2.1ppt. During this monitoring period, salinity concentration was supposed to be the lowest (0.0ppt) near the project site based on the previous post-monsoon season (2017) salinity records. But, at the last two consecutive post-monsoons due to almost zero rainfall and very low upstream freshwater availability, the salinity increased a bit even near about the project boundary (**Table B.3 of Appendix- IV**).

In the monitored river systems, the highest salinity was observed in pre-monsoon season followed by winter season. Freshwater unavailability from upstream and the dominated tidal

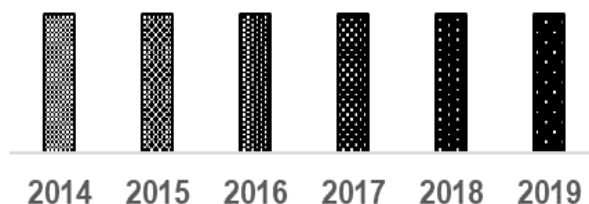


factors are the main reason of high salinity concentration in pre-monsoon and winter. The water salinity data in the selected sampling stations of Passur-Sibsa RS of the eighteenth consecutive monitoring periods are presented in **Figure 2.12** and all the observed dataset are attached in **Table B.3 of Appendix- IV**.

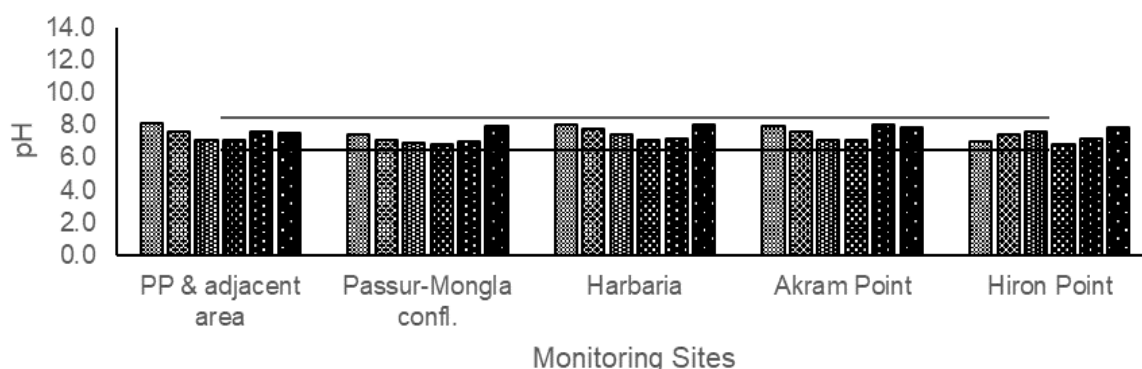
#### Dissolved Oxygen

During the 22nd monitoring period, DO concentrations ranged 7.1-10.5 mg/L. The maximum concentration was found in the South West Corner of the project boundary while the minimum value was recorded at the Ichamoti-Maidara confluence (7.1 mg/L). In case of surface water standard, DO limit must not be dropped than 5.0mg/L at any cost. Lower DO than the standard limit (ECR' 1997) will first harm the aquatic organisms (plankton) and then the fish community.

In case of seasonal variations, maximum concentrations were observed during monsoon and post monsoon season. Higher DO level was observed in monsoon and post-monsoon season, basically were for heavy rainfall and freshwater availability. During winter, salinity affects the temperature and then water temperature affects the holding capacity of DO in water. However, still the DO concentration of Passur-Sibsa RS (near project site and inside the Sundarbans), are complying with the water usable for irrigation, as irrigation usable DO concentration limit is only 5.0 mg/L (ECR, 1997). Monsoon variations of DO at the monitoring sites of Passur-Sibsa RS are shown in **Figure: 2.13** and all the observed dataset are attached in **Table B.4 of Appendix- IV**.

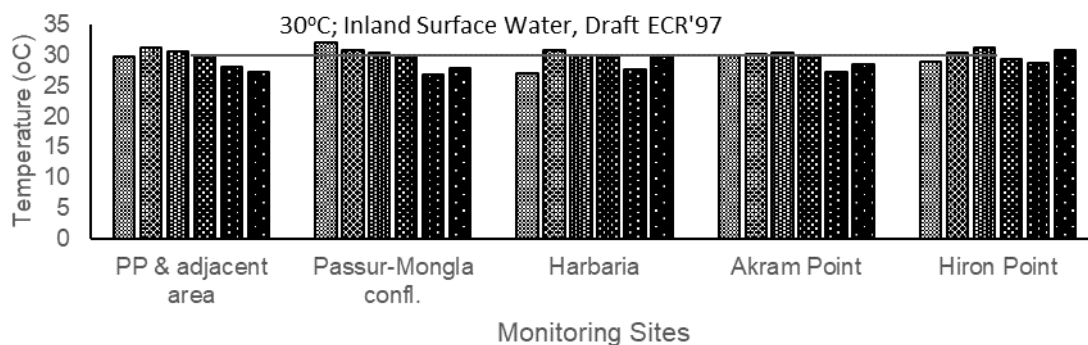


**Figure 2.9: Legend identification (left to right: 2014-2019)**

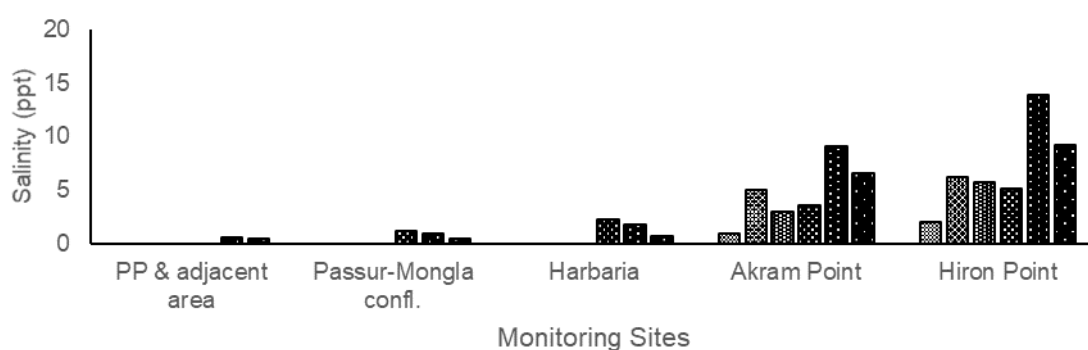


**Figure 2.10: Variations in Post-monsoon pH values in different monitoring sites**

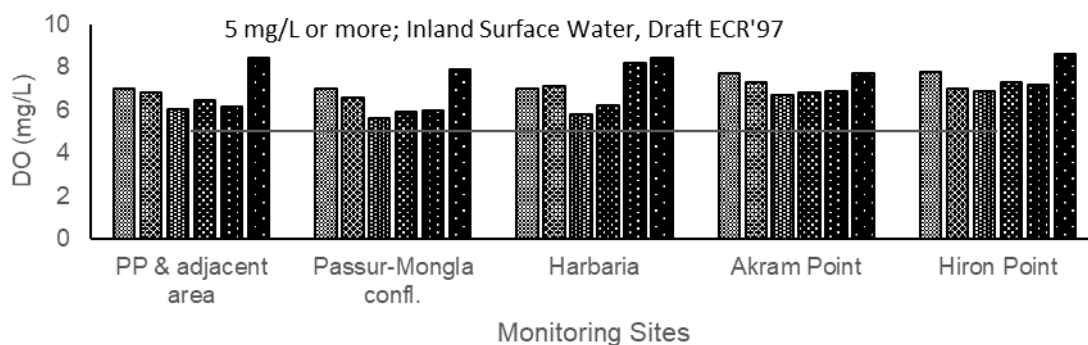




**Figure 2.11: Variations in Post-monsoon temperature in different monitoring sites**



**Figure 2.12: Variations in Post-monsoon salinity in different monitoring sites**



**Figure 2.13: Variations in Post-monsoon DO in different monitoring sites**

#### *Laboratory tested parameters*

The laboratory tested results obtained up to 21<sup>st</sup> monitoring period (July 2019: Monsoon season) are described below and the legend identification for six monitoring periods has been shown in **Figure 2.14**.

#### Total Dissolved Solids (TDS), Total Hardness (TH) and Total Suspended Solids (TSS)

Total Dissolved Solids (**TDS**) mainly indicates the presence of various kinds of minerals like ammonia, nitrate, phosphate, alkalis, some acids, sulphates and metallic ions etc., which

comprise both colloidal and dissolved solids in water (Tareq M S et al., 2013). During the last monsoon period, the TDS values were found to range between 142 mg/L to 12,500 mg/L, which was almost same as all other previous monsoon seasons (**Figure 2.15**). Above all these, the average TDS status are always showing the same pattern. For instance, TDS in power plant and adjacent areas are comparatively less than the deep Sundarbans Forests. In Passur-Sibsa RS, TDS has temporal variations as well. The TDS values during pre-monsoon and winter is high because of low rainfall and at the same time the tidal effects. The Bay of Bengal contains many minerals and turn the dominant composition of the said river system during pre-monsoon and winter. Therefore, in monsoon and post monsoon, the TDS concentration falls down to less than 200 mg/L in most of the cases excluding the deep forests. Regarding spatial variation, the more it is downstream of this RS, the higher the TDS concentrations due to tidal influence of the Bay of Bengal that contains huge of salts and other nutrients.

According to the last monsoon data of TH (2019), it has been revealed that TH showed extremely high concentration rather than other monsoon seasons (2014-2018). In the last monsoon, TH ranged 1,400-4,300 mg/L (average 2,277 mg/L) which is much higher concentrations than the monsoon of 2018. TH ranged in 2018 monsoon was 200-2,030 mg/L (average 762 mg/L) where most sites showed less than 500 mg/L of TH (**Figure 2.16**). Usually in rainy season, TH is supposed to be lower in concentrations. Last monsoon higher TH must be due to the low availability of freshwater supply from upstream of the RS and high influence of sea water from the Bay of Bengal. Seawater contains huge quantity of calcium and magnesium, which make the water hard.

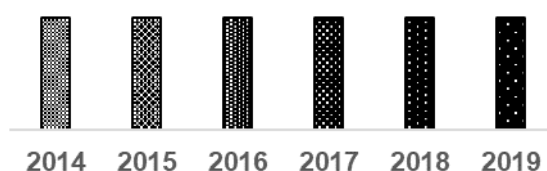
Rahman et. al. (2013) stated that during the rainy season, the average water hardness in the sampling stations of Passur river was found to be 98.47 mg/L (ranged 96.09-100.1 mg/L), whereas water hardness remarkably increased to 1,750 mg/L (ranged 1,650-1,850 mg/L) and 2,850 mg/L (ranged 2,800-2,900 mg/L) in winter and summer seasons, respectively. Hardness of seawater is reasonably higher than that of river water. Typical seawater has a calcium hardness of 1,000 mg/L, magnesium hardness of 5,630 mg/L and total hardness of 6,630 mg/L. A high level of hardness is occurred due to the divalent cations such as  $\text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$ ,  $\text{Sr}^{+2}$  etc. Cations higher than divalent can contribute low level of hardness and mono-valent cations cannot produce any hardness. The high level of hardness of the Passur river water during the winter and summer seasons at all stations may be due to the seawater intrusion from Bay of Bengal to the fresh ground water (Rahman et. al., 2013).

TSS includes solid materials of organic and inorganic in origins, which are normally suspended in water. In Passur-Sibsa RS, the suspended matters generally contain sand, clay, silt and loam. During the 21<sup>st</sup> quarterly monitoring period, the TSS concentrations among the monitoring sites varied from 11 mg/L to 15 mg/L. The highest value was found at Ichamoti-Maidara confluence while the lowest value was found at Middle of Passur River at 100m u/s of North West corner from the Project boundary). TSS values in every spot recorded during the last monsoon period found to be within the Bangladesh standard limit of 150 mg/L (ECR, 1997). Due to 2014 oil spillage, TSS was found higher than the standard limit at 2015. After that, the issue was not found any more, and the river system revived naturally.

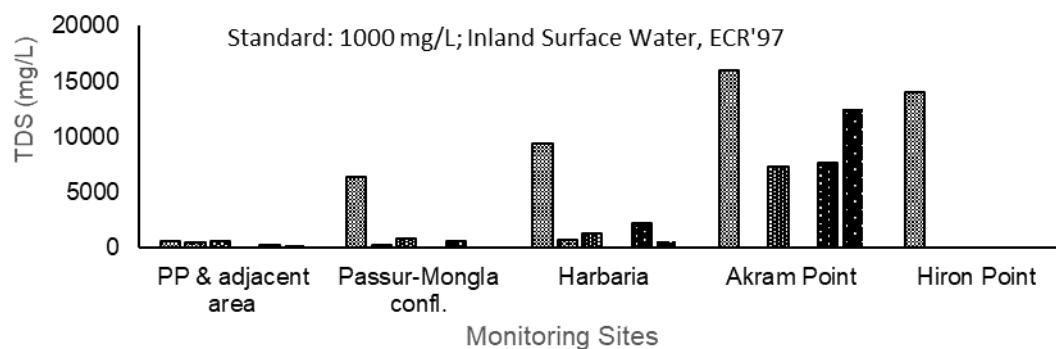
Generally, in Passur-Sibsa RS, TSS was found to be higher in post-monsoon and winter season than those of pre-monsoon and monsoon. During post-monsoon and winter season, the TSS value increases, probably due to comparatively low amount of rains and less

freshwater flow, urban runoff, industrial wastes, bank erosion, bottom feeders (such as carp), algae growth or wastewater discharges (**Figure 2.17**).

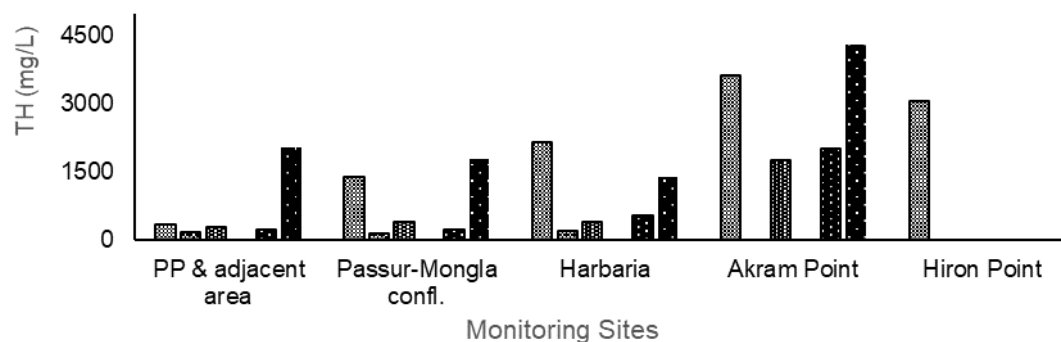
The status of TDS, TH and TSS of Passur River in the monitored post-monsoon seasons at different monitoring sites are presented in **Figure 2.15**, **2.16** and **2.17** respectively and all the observed dataset are attached in **Table B.8**, **Table B.9** and **Table B.10** of **Appendix-IV**.



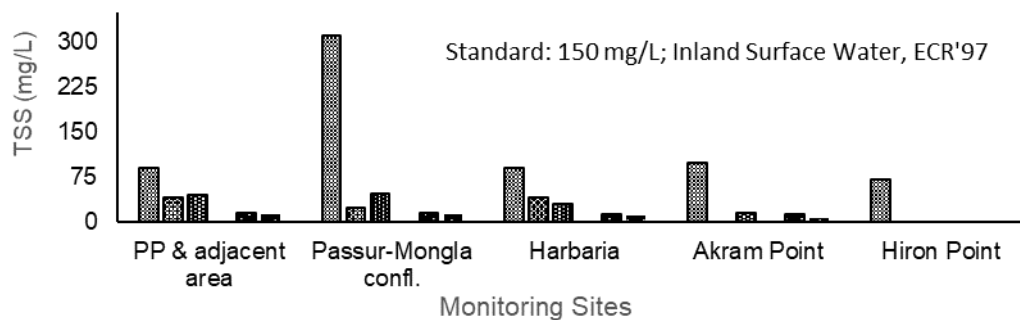
**Figure 2.14: Legend identification (left to right: 2014-2019)**



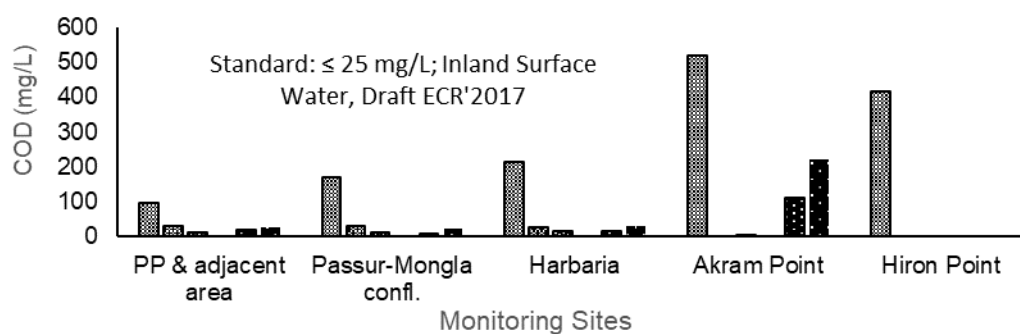
**Figure 2.15: Variations in monsoon TDS concentrations in different monitoring sites**



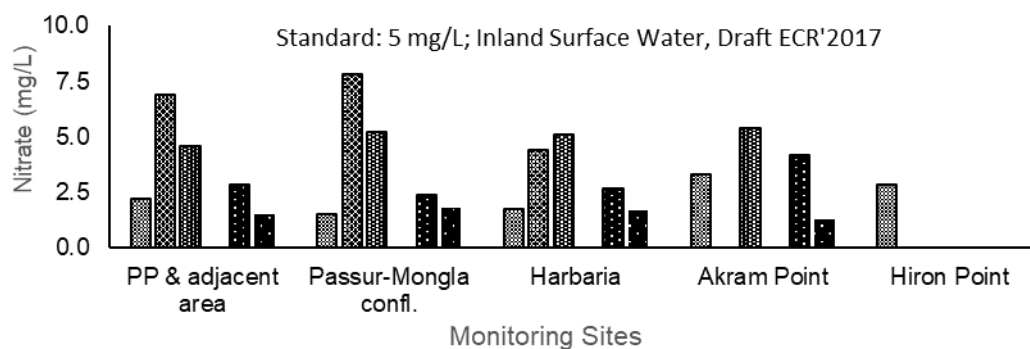
**Figure 2.16: Variations in monsoon TH status in different monitoring sites**



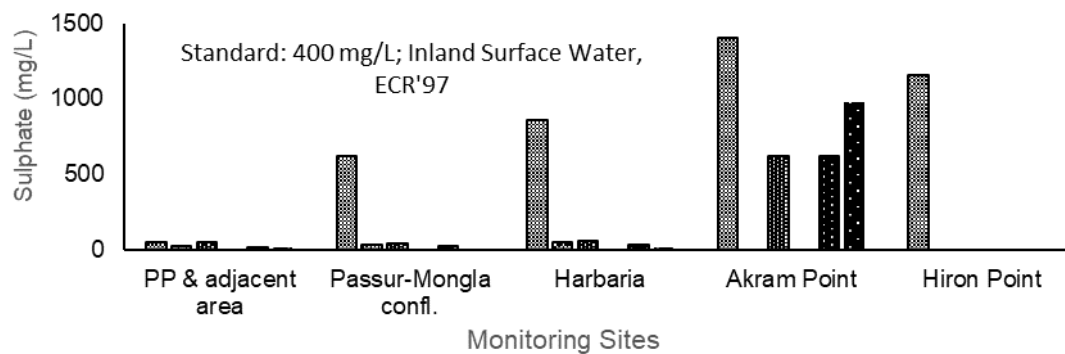
**Figure 2.17: Variations in monsoon TSS concentrations in different monitoring sites**



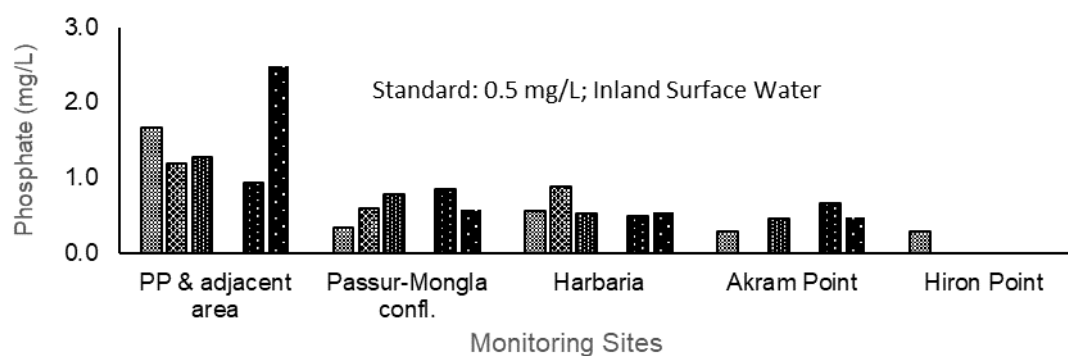
**Figure 2.18: Variations in monsoon COD concentrations in different monitoring sites**



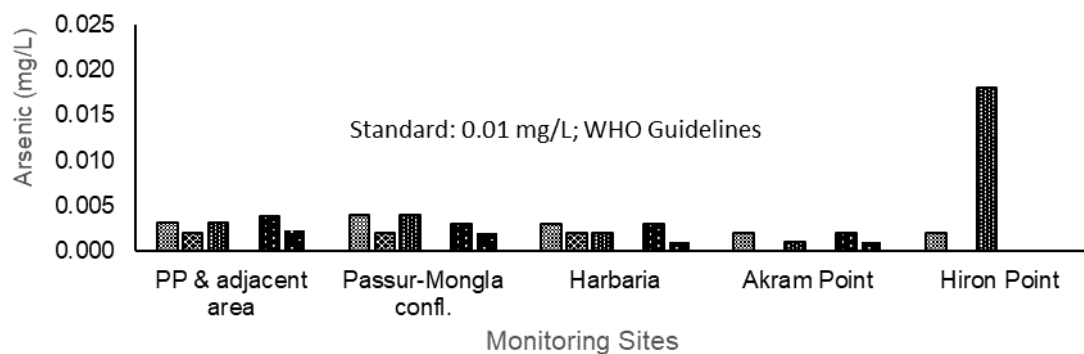
**Figure 2.19: Variations in monsoon Nitrate concentrations in different monitoring sites**



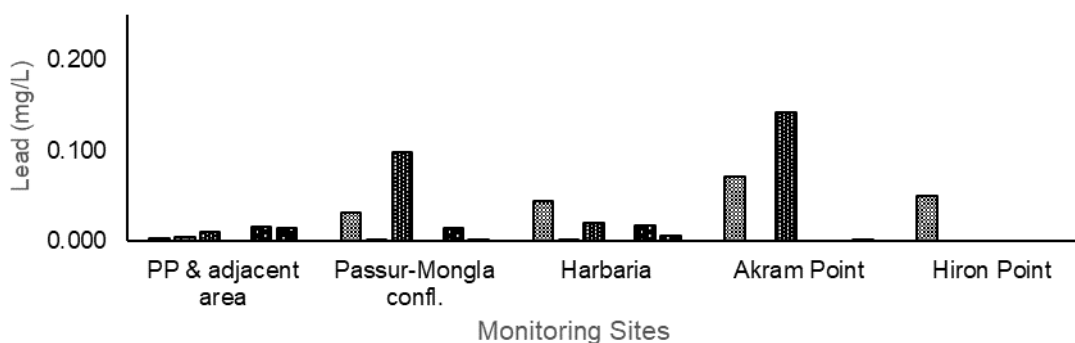
**Figure 2.20: Variations in monsoon Sulphate concentrations in different monitoring sites**



**Figure 2.21: Variations in monsoon Phosphate concentrations in different monitoring sites**



**Figure 2.22: Variations in monsoon Arsenic concentrations in different monitoring sites**



**Figure 2.23: Variations in monsoon Lead concentrations in different monitoring sites**

#### Chemical Oxygen Demand (COD)

COD is an indicator of organic pollution, which is caused by the inflow of natural organic loads, domestic, livestock and industrial wastes, which contain elevated levels of organic pollutants (Ayati, 2003). In fact, the higher the organic matter, the higher will be the decomposition and hence there will be a higher demand of O<sub>2</sub> in the water body.

COD concentrations varied from 20 mg/L to 220 mg/L during the last monsoon season. The highest value was found at the Akram point. The high values of COD indicate high level of organic pollution in the river water (Sivasubramaniam, 1999). **Figure 2.18** indicates that, organic loads are higher in the deep forests of Sundarbans than the upstream areas especially the power plant and its adjacent areas. Deep forests supply many organic loads in the river while upstream loads as well increase the organic materials concentrations in huge at the downstream of the RS. COD concentrations of most of the monitoring sites is compiled with the Draft ECR' 2017 (25 mg/L) inland surface water standard during the last monsoon season except Left Bank of Passur River at 100m u/s of North West corner from the Project boundary (36 mg/L), Right Bank of Passur River at 100m u/s of North West corner from the Project boundary (32 mg/L), Harbaria (32 mg/L) and Akram point (220 mg/L). Various activities at project jetty may influence the COD continuously. The extreme high COD at 2014 was the reason of oil spillage of that year which lead the death of planktons and other aquatic life forms ultimately increased the organic matter decomposition rate.

Over the year, COD concentration was found to be higher in pre-monsoon season followed by winter as these seasons had insignificant rainfall comparing to those of other seasons and which actually increased the density of organic matter. The COD concentrations of pre-monsoon and winter seasons (dry) were found higher than those of monsoon and post-monsoon seasons. In monsoon, higher discharge diluted the COD load of the river water, which in turn reduced COD concentration in post monsoon. All observed values of COD are shown in **Figure 2.18** and the completely monitored dataset are provided in **Table B.6 of Appendix- IV**.

#### Nitrate, Sulphate and Phosphate

In the last monitoring, NO<sub>3</sub><sup>-</sup> concentrations varied from around 0.1 mg/L to 3.1 mg/L. The maximum concentration of 3.1 mg/L, recorded at Ichamoti-Maidara confluence whilst lowest

concentration of 0.1 mg/L was found at the Left Bank of Passur River at 100m u/s of North West corner from the Project boundary. The highest concentration at Ichamoti-Maidara confluence was because of the agricultural runoff from adjacent crop fields during the monsoon period.

$\text{NO}_3^-$  concentration showed both temporal and spatial variations in the same season of all 21 monitoring. For instance, in the last monsoon season, power plant and its adjacent areas  $\text{NO}_3^-$  concentration was less than 2.0 mg/L and at the same location it was found almost double (3.0 mg/L) in the monsoon season of 2018 and 5.0 mg/L of 2016. In case of spatial variation, at the left Bank of Passur River at 100m u/s of North West corner from the Project boundary,  $\text{NO}_3^-$  concentration was found 4.0 mg/L at 2016 and it reduced to 1.0 mg/L at 2018 and 0.1 mg/L at 2019 (**Figure 2.19**).

It is noticeable that, the more the upstream of the RS the lower the nitrate concentrations during the last monsoon period. However, the results obtained from all the monitoring sites were found to be within the standard concentration stated in ECR'1997 (5.0 mg/L for inland surface water; SCHEDULE-3).

$\text{SO}_4^{2-}$  concentration is higher in seawater as well as in coastal river due to tidal interactions. The monitored dataset substantiates this fact i.e.,  $\text{SO}_4^{2-}$  concentration of Passur-Sibsa RS increases in the direction of upstream to downstream. However, this variation is visible clearly in monsoon and pre-monsoon seasons only. Freshwater availability from upstream makes this variation.

The highest value (980 mg/L) of sulphate was found at Akram Point while the lowest value of 12 mg/L was at the Maidara River near Township area. However, all the observed dataset of Sulphate ( $\text{SO}_4^{2-}$ ) was found beyond the drinking standard limit (400 mg/L) specified in ECR, 1997 except Akram Point. Sulphate starts usually to increase from winter season and reaches at its highest peak in pre-monsoon season. Comparatively lower concentration of  $\text{SO}_4^{2-}$  in monsoon and post monsoon seasons could be due to the dilution effect of upstream freshwater (**Figure 2.20 and Table B.12, Appendix- IV**).

$\text{PO}_4^{3-}$  concentrations were found in between 0.5 mg/L and 11.1 mg/L during the last monitoring period (Monsoon 2019) (**Figure 2.21**). Based on the **Figure 2.21**, it is verified that,  $\text{PO}_4^{3-}$  concentration decrease in the direction of upstream to downstream of the RS. Upstream anthropogenic activities probably the reason for this kind of trend. Including Left Bank of Passur River at 100m u/s of North West corner from the Project boundary and Left bank of South West corner (More than 10.0 mg/L), all the other monitoring sites were found at the marginal range of 0.5 mg/L of phosphate (ECR' 1997 rules of 0.5 mg/L of  $\text{PO}_4^{3-}$  in the inland surface water).

The recorded low phosphates value during dry seasons might be attributed to the limited flow of upstream freshwater, high salinity and utilization of phosphate by phytoplankton, stated by Senthilkumar et al., 2002; Rajasegar, 2003 (**Table B.13**).

$\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$  and  $\text{PO}_4^{3-}$  concentrations at different monitoring sites of the 18 consecutive monitoring periods are shown in **Figure 2.19, 2.20 and in 2.21** and all the observed dataset are given in **Table B.11, Table B.12 and Table B.13 of Appendix- IV**.

### Heavy Metals

It has earlier been revealed that Arsenic (As) concentrations varied between 0.001 to 0.006



mg/L. During this 21<sup>st</sup> monitoring, the results (0.001-0.004 mg/L) again fitted with the said range. Though there were some seasonal variations in As concentrations, but still As concentration complies with the drinking water quality standard of WHO (0.01 mg/L). The Bangladesh limit is as high as of 0.05 mg/L (**Figure 2.22**).

Lead (Pb) dissolved in water is very harmful to aquatic organisms; due to bioaccumulation, it increases in body tissue of organisms (Rompas, 2010). It is also evident that organic fertilizer, which comes from lime and compost fertilizers, can contain heavy metal, e.g., NPK fertilizer (phosphate fertilizers containing Pyromorphite-  $Pb_5(PO_4)_3$  like the way said by Zhu et. al., 2004), which may result in higher amount of Pb concentration in river water. During 21<sup>st</sup> monitoring period, the concentration of Pb ranged 0.001-0.12 mg/L (**Figure 2.23**). The standard concentration for inland surface water is 0.1 mg/L. Only at Left Bank of Passur River at South West corner from the Project boundary showed highest concentration of 0.12 mg/L of lead.

The values of Hg (Mercury) revealed a continuous consistency among all the spots in all the seasons. The values never exceeded 0.001 mg/L. In the monsoon, the concentrations persisted also the same. All the observed data found to be within the Bangladesh standard limit (0.05 mg/L) set by the ECR, 1997 of Bangladesh.

The average value of As and Pb concentrations at different monitoring sites of the consecutive monitoring periods for winter season are presented in **Figure 2.22 and 2.23** and all the observed dataset are given in **Table B.14, Table B.15 and Table B.16 of Appendix-IV**.

#### Oil and Grease

In order to measure the concentration of oil and grease in Passur-Sibsa River, samples were collected at five locations during low tide from the surface layer and analyzed following the standard testing method of APHA. The concentration of oil and grease are presented in **Table-B.7 of Appendix-IV**.

During monsoon and post monsoon periods, the concentration of oil and grease were found lower than that of winter and pre-monsoon season. It appears from the data that Passur and Sibsa river system recorded high concentration of oil and grease in winter period in 2014, which might be due to accidental oil spillage occurred on 9<sup>th</sup> December 2014. An amount of 350,000 litres (Philips, 2014) of furnace oil had spilled in the river and spread over an area of 350 km<sup>2</sup> (Welle, 2014).

Oil and grease were found to be <2.0 mg/L for all the monitoring sites in the last monsoon season. Oil and grease showed both spatial and temporal variations. In other seasons (pre-monsoon, monsoon and post monsoon), this organic compound has increased in the last three consecutive years. Plying of motorized boats, launches and other tourist boats could be the reasons of high oil and grease including the RASH MELA Festival inside Sundarbans every year. Moreover, for the seasonal fishing at sea, the engine boats and other fishing boats contributes huge amount of oil and grease in the river water. Therefore, due to oil spillage and discharges of other organic residual from large number of marine vessels in the location; oil discharge from the fishing boats and other anthropogenic activities might be the reason of having such higher amount of oil and grease concentration.



### Total Organic Carbon

Total Carbon (TC) represents all the carbon in the sample, including both inorganic and organic carbon. Total Organic Carbon (TOC) is the amount of carbon found in an organic compound and is often used as a non-specific indicator of water quality or cleanliness of pharmaceutical manufacturing equipment. Total Inorganic Carbon (TIC) often referred to as inorganic carbon (IC), carbonate, bicarbonate, and dissolved carbon dioxide (CO<sub>2</sub>).

This study only considers TOC, which is very important in detecting contaminants in drinking water, cooling water, water used in semiconductor manufacturing, and water for pharmaceutical use. Two sites of Project Jetty and Harbaria were monitored for TOC concentrations. According to the monitoring results, it was found that TOC concentrated less than 5.0 mg/L in each site. The normal standard for TOC varies from 7.0 mg/L to 10.0 mg/L in the river. Observed surface water is safe from TOC contaminant so far.

### PAHs (Polycyclic aromatic hydrocarbons)

**Polycyclic aromatic hydrocarbons (PAHs, also *polyaromatic hydrocarbons* or *polynuclear aromatic hydrocarbons*)** are hydrocarbons-organic compounds containing only carbon and hydrogen that are composed of multiple aromatic rings (organic rings in which the electrons are delocalized). PAHs are uncharged, non-polar molecules found in coal and in tar deposits. They are also produced by the thermal decomposition of organic matter (for example, in engines and incinerators or when biomass burns in forest fires).

Most PAHs are insoluble in water, which limits their mobility in the environment, although PAHs sorb to fine-grained organic-rich sediments. Aqueous solubility of PAHs decreases approximately logarithmically as molecular mass increases. Two-ringed PAHs, and to a lesser extent three-ringed PAHs, dissolve in water, making them more available for biological uptake and degradation. Further, two- to four-ringed PAHs volatilize sufficiently to appear in the atmosphere predominantly in gaseous form, although the physical state of four-ring PAHs can depend on temperature. In contrast, compounds with five or more rings have low solubility in water and low volatility; they are therefore predominantly in solid state, bound to particulate air pollution, soils, or sediments. In solid state, these compounds are less accessible for biological uptake or degradation, increasing their persistence in the environment.

PAHs have a strong affinity for organic carbon, and thus highly organic sediments in rivers, lakes, and the ocean can be a substantial sink for PAHs. Algae and some invertebrates such as protozoans, mollusks, and many polychaetes have limited ability to metabolize PAHs and bio-accumulate disproportionate concentrations of PAHs in their tissues; however, PAH metabolism can vary substantially across invertebrate species. Most vertebrates metabolize and excrete PAHs relatively rapidly. Tissue concentrations of PAHs do not increase (bio-magnify) from the lowest to highest levels of food chains.

PAHs transform slowly to a wide range of degradation products. Biological degradation by microbes is a dominant form of PAH transformation in the environment. Soil-consuming invertebrates such as earthworms speed PAH degradation, either through direct metabolism or by improving the conditions for microbial transformations. Abiotic degradation in the atmosphere and the top layers of surface waters can produce nitrogenated, halogenated,

hydroxylated, and oxygenated PAHs; some of these compounds can be more toxic, water-soluble, and mobile than their parent PAHs.

During the last monitoring (monsoon), the PAHs was undetectable near the Project jetty site and at the Harbaria. It indicates that there were no PAHs pollution until now in the Passur-Sibsa RS.

### *Findings*

Passur River is highly influenced by tidal effects. Tidal penetration in the Passur River depends on seasonal change, upstream flow and catchment water discharge. Considering these scenarios, the physico-chemical properties of Passur River changes with tidal intrusion in different seasons. In the 22<sup>nd</sup> quarter (Post-monsoon 2019), only salinity was recorded comparatively higher but still under the recommended value of ECR'1997. In contrary, pH, Temperature and DO level was found favorable for the residing aquatic life forms. Huge construction activities and land filling near the bank side didn't reduce the DO level at all.

During 21<sup>st</sup> quarter (Monsoon, 2019) monitoring, lab tested parameters, TDS and TSS did not increase in respect to the same seasons of last five consecutive years. However, TH was found extremely higher than other monsoon seasons. This change was because of tidal intrusion during monsoon and less freshwater availability. COD was low in concentration in most of the monitoring sites except few. Nitrate ( $\text{NO}_3^-$ ) and sulphate ( $\text{SO}_4^{2-}$ ) was comparatively low in concentrations rather than other seasons. Phosphate ( $\text{PO}_4^{3-}$ ) concentration showed slightly higher concentration than the Standard of Inland Surface Water Quality (0.05 mg/L) especially in some of the power plant adjacent areas. It was also found that rather than construction activities,  $\text{PO}_4^{3-}$  was coming from the agricultural practices, surface run-off from upstream and plankton decay in the river itself.

In case of metal pollution, no variation was recorded for As, Pb and Hg concentration and even no issues as well. Oil & grease concentration was found less than 5 mg/L, which is even less than half of the recommended concentration (10 mg/L) for Inland Surface Water.

Lastly, organic pollution was found undetectable in Passur-Sibsa RS especially for TOC and PAHs.

### **2.8.10 Status of the Groundwater quality**

#### *In-situ tested parameters*

The in-situ tested results obtained up to 22<sup>nd</sup> monitoring period (October 2019: Post-monsoon season) are described below and the legend identification for all six monitoring periods has been shown in **Figure 2.24**.

#### pH and Temperature

The values of pH and temperature of groundwater in the monitored sites complied with the drinking water quality standards as specified in ECR, 1997 (6.5-8.5 and 20-30°C respectively). The pH values during 22<sup>nd</sup> monitoring scheme were found to vary from 7.2 to 7.6, while temperature was ranged 26°C to 27°C. No significant differences have been observed in relation to the previous post-monsoon season. Similarly, no significant variation was recorded in groundwater temperature over the monitoring periods.

Both the results of pH and Temperature were found more or less consistent with all those to

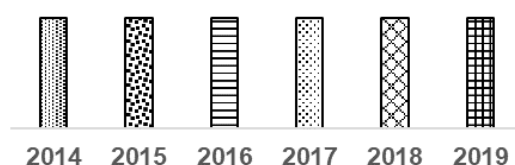
the previously obtained respective season's data. The 22<sup>nd</sup> consecutive monitoring results of pH and temperatures of selected sites are presented in **Figure 2.25: pH and Temperature**. However, for all the observed dataset and are attached in **Table B. 17** of **Appendix- IV**.

#### Salinity and Dissolved Oxygen (DO)

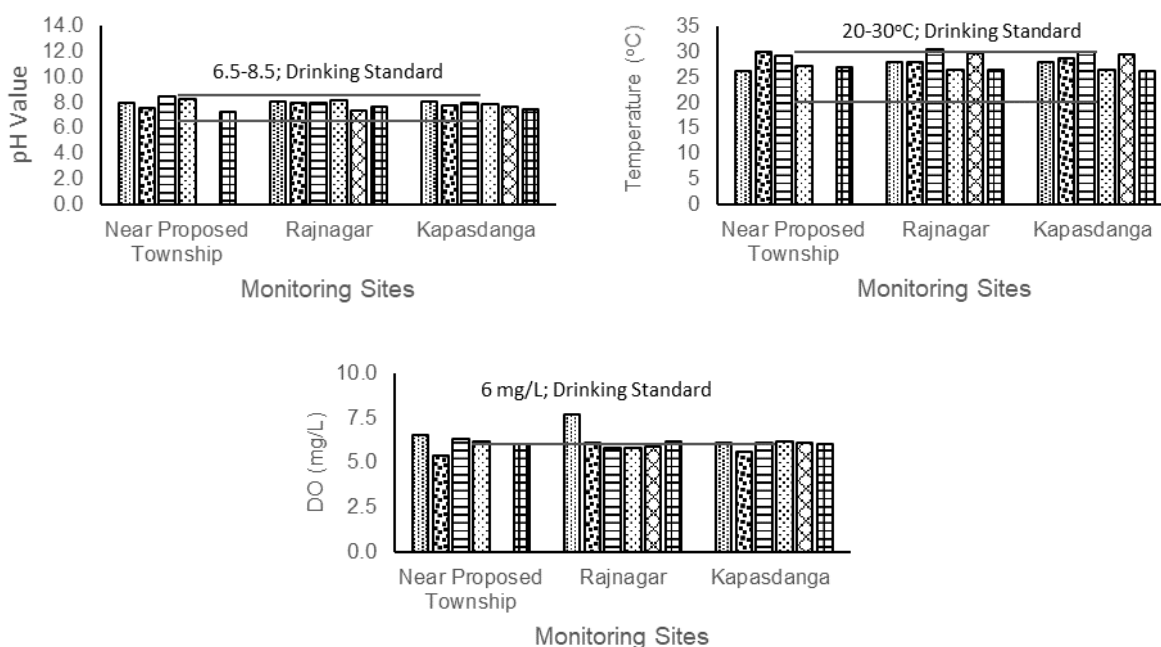
Groundwater salinity concentration in all the monitoring sites were found to be negligible and in most of the cases below, the minimum detectable limits in all the consecutive monitoring seasons. During this monitoring season, groundwater salinity of all three sites were found to be 0.0 ppt averagely.

DO ranged between 6.0 mg/L to 6.2 mg/L during the last monitoring season. DO concentration were found acceptable recommended by ECR, 1997 (6.0mg/L). A slight low DO concentration in drinking water might only reduce the taste of water. Higher DO level makes water tastier but causes corrosion to the supply pipe.

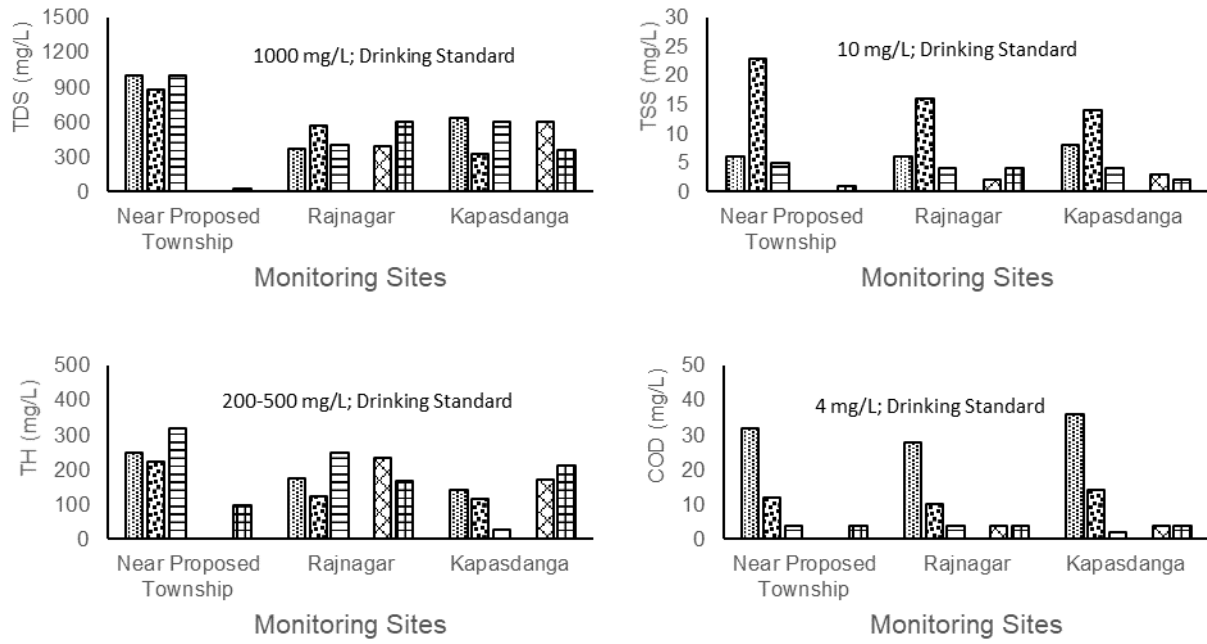
All monitoring results of DO of the selected monitoring sites are presented in **Figure 2.25: DO** and all the observed dataset of DO and Salinity are attached in **Table B.18** of **Appendix- IV** respectively.



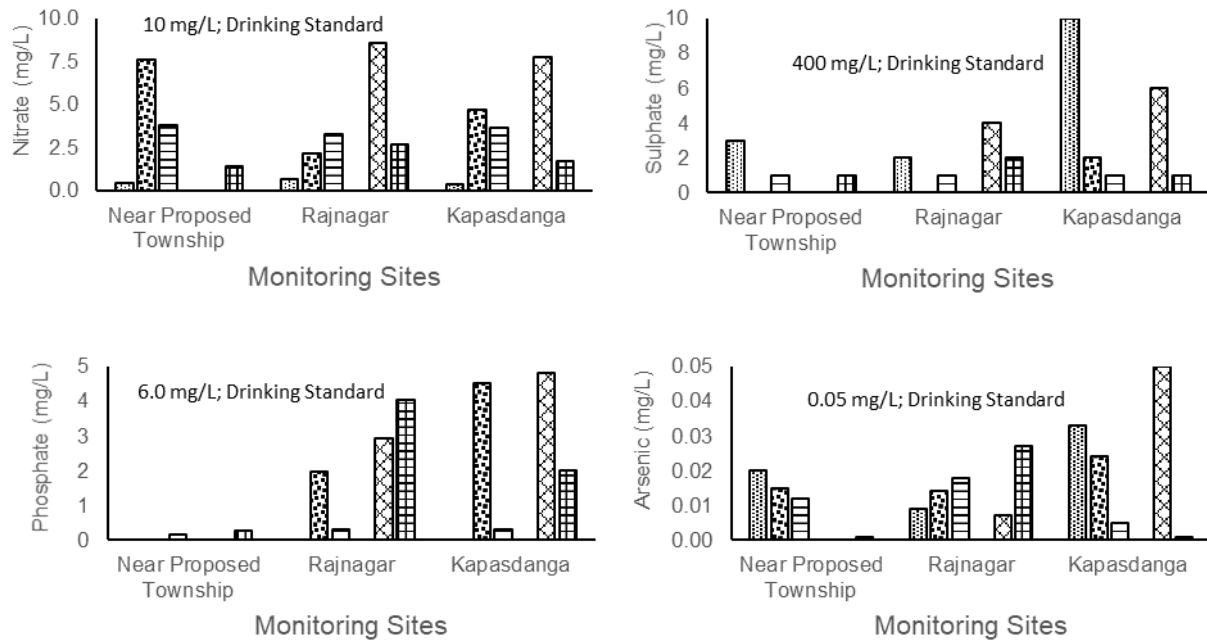
**Figure 2.24: Legend identification (left to right: 2014-2019)**

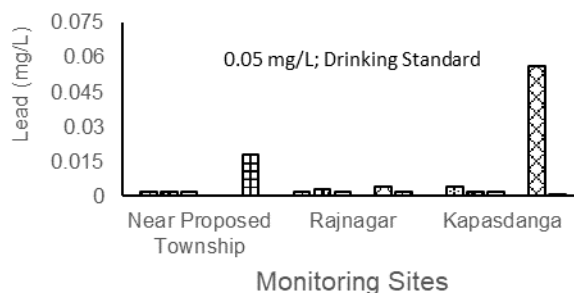


**Figure 2.25: Status of pH, Temperature and DO of post-monsoon seasons of the last six consecutive years of monitoring**



**Figure 2.26: Status of TDS, TSS, TH and COD of monsoon seasons of the last six consecutive years of monitoring**





**Figure 2.27: Status of Nitrate, Sulphate, Phosphate, Arsenic and Lead of monsoon seasons of the last six consecutive years of monitoring**

#### *Laboratory tested parameters*

The laboratory tested results obtained up to 21<sup>st</sup> monitoring period (July 2019: monsoon season) are described as follows:

#### TDS, TSS and TH

The highest TDS value of 602 mg/L was recorded in Rajnagar and the lowest was in Township area (25 mg/L). It is mentionable that, the TDS concentrations in all the monsoon periods were found within the Bangladesh standard limit of 1000 mg/L (ECR, 1997) (**Figure 2.26: TDS**). Until now, TDS did not come out as an issue in the monsoon season. However, in the pre-monsoon season of the year 2014, TDS showed extreme spatial variations. That variation was for the physically damaged (damaged pipes) of the observed Tube wells for a while.

TSS, also known as non-filterable residue, are the solids (minerals and organic material) which remain trapped on a 1.2µm filter (U.S.EPA, 1998). During this monitoring period, the TSS concentrations ranged in between 1-4 mg/L, which complied with the Standard for Drinking Water Quality, Bangladesh (TSS: 10 mg/L, ECR, 1997) (**Figure 2.26: TSS**). Among all the monitoring seasons, the observed TSS concentrations were much lower in monsoon season than the winter season. These variations would be due to lack of freshwater availability for sufficient groundwater recharging during winter. In addition, evaporation have also condensed the water along with its suspended matters in winter.

TH of the monitored spots varied from 97 mg/L to 212 mg/L (**Figure 2.26: TH**) in the last monsoon season. Kapasdanga showed the highest concentration only in the last monsoon while Rajnagar showed the highest hardness during the other monitoring periods. Over the six monsoon seasons, drinking water hardness complied with standard limit (200-500 mg/L) set by the ECR 1997. So far, no incidents of weathering of  $\text{Ca}^{2+}$  bearing minerals or excessive application of lime was found during the monitoring periods which could cause excessive amount of TH in groundwater.

Groundwater TDS, TSS and TH values of the consecutive monsoon periods are presented in **Figure: 2.26: TDS, TSS and TH** and all the observed dataset are attached in **Table B.19, B.20 of Appendix- IV**.

#### Chemical Oxygen Demand

The Bangladesh standard for COD in drinking water is 4.0mg/L. Monitoring sites completely



complied with the Bangladesh Standard as COD concentrations for these sites in the last monsoon period were found only 4.0mg/L. Except first and second quarterly monitoring period, all the other monsoon seasons COD concentrations were also within the recommended drinking limit for Bangladesh.

The COD concentrations of all the monsoon periods are given in **Figure 2.26: COD** and all the observed dataset are attached in **Table B.21 of Appendix- IV**.

#### Nitrate, Sulphate and Phosphate

$\text{NO}_3^-$  values ranged between 1.4 mg/L and 2.7 mg/L in the last monsoon period (**Figure 2.27: Nitrate**). The maximum value was recorded in Rajnagar while the lowest was in Township area.  $\text{NO}_3^-$  concentrations were relied within the ECR, 1997 limit (10mg/L) in this 21<sup>st</sup> monitoring period.  $\text{NO}_3^-$  in groundwater showed both spatial and temporal variations in monsoon season.

$\text{SO}_4^{2-}$  concentrations in groundwater have been monitored since 2015. On that time,  $\text{SO}_4^{2-}$  concentrations have been complying with the Bangladesh Standard for Drinking Water Quality (400 mg/L).  $\text{SO}_4^{2-}$  concentration in groundwater did not show any pattern yet (**Figure 2.27: Sulphate**) except a trend of comparatively high concentrations in winter than all other monitoring seasons.

On the other hand, the concentrations of  $\text{PO}_4^{3-}$  were ranged between 0.3 mg/L and 4.0 mg/L, which was within the standard limit of 6.0 mg/L (ECR'1997) (**Figure 2.27: Phosphate**).  $\text{PO}_4^{3-}$  concentration reached to its highest peak at 4.8 mg/L in the monsoon of 2018.  $\text{PO}_4^{3-}$  concentrations actually have both spatial and temporal variations but which is minor in the interest of this monitoring objectives as well as drinking purpose by the community resides there.

The observed winter seasons  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$  and  $\text{PO}_4^{3-}$  concentrations of groundwater are presented in **Figure 2.27: Nitrate, Sulphate and Phosphate**, and all the observed dataset are attached in **Table B.22, B.23, and B.24 of Appendix- IV**.

#### Arsenic (As), Lead (Pb) and Mercury (Hg)

According to Bangladesh Standard (ECR, 1997), the maximum acceptable concentration of Arsenic (As) in groundwater is 0.05 mg/L. The As concentrations among all the monitoring locations ranged between 0.01 mg/L and 0.05 mg/L which are very much within the Bangladesh standard for drinking water quality (ECR, 1997) (**Figure 2.27: Arsenic**). It can therefore, be concluded that, groundwater of the monitoring areas is not contaminated by arsenic pollution yet.

Lead (Pb) and Mercury (Hg) concentrations were also measured and the values were found within the permissible limit specified in ECR 1997 (0.05 mg/L for Pb and 0.001 mg/L for Hg). The concentration of Pb showed only spatial variation to some extent (**Figure 2.27: Lead**). However, the water of the tube-wells was found suitable for drinking purpose in terms of metal pollution status.

The observed values of As and Pb in all the monsoon period are presented in **Figure: 2.27: Arsenic, Lead** and all the observed dataset of As, Pb and Hg are presented in **Table B.25, B.26 and B.27 of Appendix-IV**.

### Remarks

This concluding remark only represent the status of monsoon season of the monitoring scheme. It has been observed that the physical characteristics of groundwater quality is still in good condition and in acceptable state for drinking purpose. In addition, dissolved and solid quantities of the water are also found very low than the highest recommended limit for Bangladesh. Only, chemical oxygen demand during 2014 and 2015 was higher than ECR, 1997. Other nutrients like nitrate, sulphate and phosphate met the Bangladesh demand completely together with the metals of arsenic, lead and mercury.

## 2.9 Land Resources monitoring

### 2.9.1 Methodology

Monitoring of selected indicators are very crucial for better management of land resources in the study area. Plot/land use, soil fertility/nutrient status, soil contamination with heavy metals and soil salinity are considered as the major indicators for land resources monitoring. It is also assumed that during the operation phase of the power plant fly ash and other air borne pollutants may get deposited on the surrounding agriculture land, which ultimately may pollute the study area soil. Before that (during pre-construction and construction stage), only natural phenomena are responsible to alter soil parameters.

#### Sampling Frequency

The frequency of monitoring for land resources data collection was considered twice in a year. Accordingly, the plot use data was collected in the 22<sup>nd</sup> monitoring program during November 1<sup>st</sup> 2019 to November 16<sup>th</sup> 2019.

#### Monitoring Indicators

The continuous monitoring has given an opportunity to observe seasonal change along with spatial change of selected indicators of sampling plots. The selected indicators are soil reaction (pH), soil salinity (EC), Organic matter (OM), base cations-Ca, Mg, K and Na, status of macro nutrients (N, P and S), status of micro nutrients (B, Fe, Mn and Zn) and presence of heavy metals (Pb and Cd). Sodium absorption ratio (SAR), exchangeable sodium percentage (ESP) can be calculated from the analysed data. It can also be mentioned that the structural change of soils in the sampling plots may also be identified from these data.

The formula to calculate SAR is given below, with concentration expressed in mill equivalents per liter (meq/L) has been analyzed from a saturated paste soil extract.

$$SAR = \frac{[Na^+]}{\sqrt{\frac{1}{2} ([Ca^{2+}] + [Mg^{2+}])}}$$

ESP is the sodium absorbed on soil particles as a percentage of the Cation Exchange Capacity (CEC). It is calculated as:

$$ESP = \frac{[Na^+]}{CE} \times 100$$

CEC is often estimated as the major exchangeable cations, including hydrogen. Both cation exchange capacity and ESP can also be calculated as:

$$\text{ESP} = \frac{[\text{Na}^+]}{[\text{Ca}^{2+} + \text{Mg}^{2+} + \text{Na}^+ + \text{K}^+]} \times 100$$

ESP is used to characterize the sodicity of soils only, whereas SAR is applicable to both soil and soil solution or irrigation water.

#### *Location*

The selected mauzas are Baranpara (E-89°30'59.1", N-22°37'57.0") of Batiaghata Upazila, Chunkuri-2 (E-89°32'20.0", N-22°34'51.0") of Dacope Upazila, Kapalirmet (E-89°36'8.8", N-22°32'18.9") of Mongla Upazila, Chakgona (E-89°34'25.3", N-22°34'18.3") of Rampal Upazila and Basherhula (E-89°34'25.0", N-22°36'14.0") of Rampal Upazila under Khulna and Bagerhat Districts. However, a new sampling location (Bidyarbon- E-89°34'40.0", N-22°33'42.0") of Mongla Upazila has been included with the previous ones for monitoring as per TOR. The sampling locations are stated in **Table 2.9**. Locations of collected soil samples are presented in **Figure 2.30**.

### **2.9.2 Process of Soil Samples Collection**

#### *Plot Selection*

Monitoring plots were selected at the very beginning of this study. Expert's judgement along with plot owner's opinion was taken into consideration for this selection. Upazila Agriculture Officers of Batiaghata and Dacope of Khulna, Rampal and Mongla of Bagerhat District and Senior Scientific Officer of Soil Resource Development Institute (SRDI) of Khulna were contacted for collecting expert's judgement. Wind speed and wind direction were considered as potential local factor for the monitoring purpose. All the selected plots were characterized as medium high land (F1), which are normally flooded in the range of 30-90 cm and remain inundated for more than two weeks to few months during the flood period.

#### *Soil Samples Collection*

Standard procedure was maintained during the collection of soil samples. In every plot, minimum three pits were dug through augur to collect composite sample (**Figure 2.31 to Figure 2.34**). Each plot had three composite samples, top soil (0-15 cm), sub soil (15-30 cm) and sub stratum (30-45 cm). Soil samples were preserved in an air-tight plastic bag for laboratory analysis.



**Figure 2.28: Soil sample collection from sampling plot-5 (Baserhula)**



**Figure 2.29: Soil sample collection form Sampling plot-2 (Chunkuri-2)**

**Table 2.9: Land Resources Monitoring Plan**

Site No.	Monitoring indicators	Location	GPS (Decimal Degree)		Sampling Frequency	Methods/ Tools/ Techniques
			Easting	Northing		
1	Plot use, Soil fertility and Nutrient, Chemical Properties of Soil (pH, Pb, Cd), Crop production and damage	Mauza: Baranpara Union: Gangarampur Upazila: Batiaghata, District: Khulna	E-89°30'59.1"	N-22°37'57.0"	Bi-yearly (April and October)	In situ field sampling and Laboratory Testing in SRDI
2		Mauza: Chunkuri-2 Union: Bajua Upazila: Dacope District: Khulna	E-89°32'20.0"	N-22°34'51.0"		
3		Mauza: Kapalimet/ Buridmial Union: Burirdanga Upazila: Mongla District: Bagerhat	E-89°36'8.8"	N-22°32'18.9"		
4		Mauza: Chakgona Union: Rajnagar Upazila: Rampal District: Bagerhat	E-89°34'25.3"	N-22°34'18.3"		
5		Mauza: Basherhula Union: Rajnagar Upazila: Rampal District: Bagerhat	E-89°34'25.0"	N-22°36'14.0"		





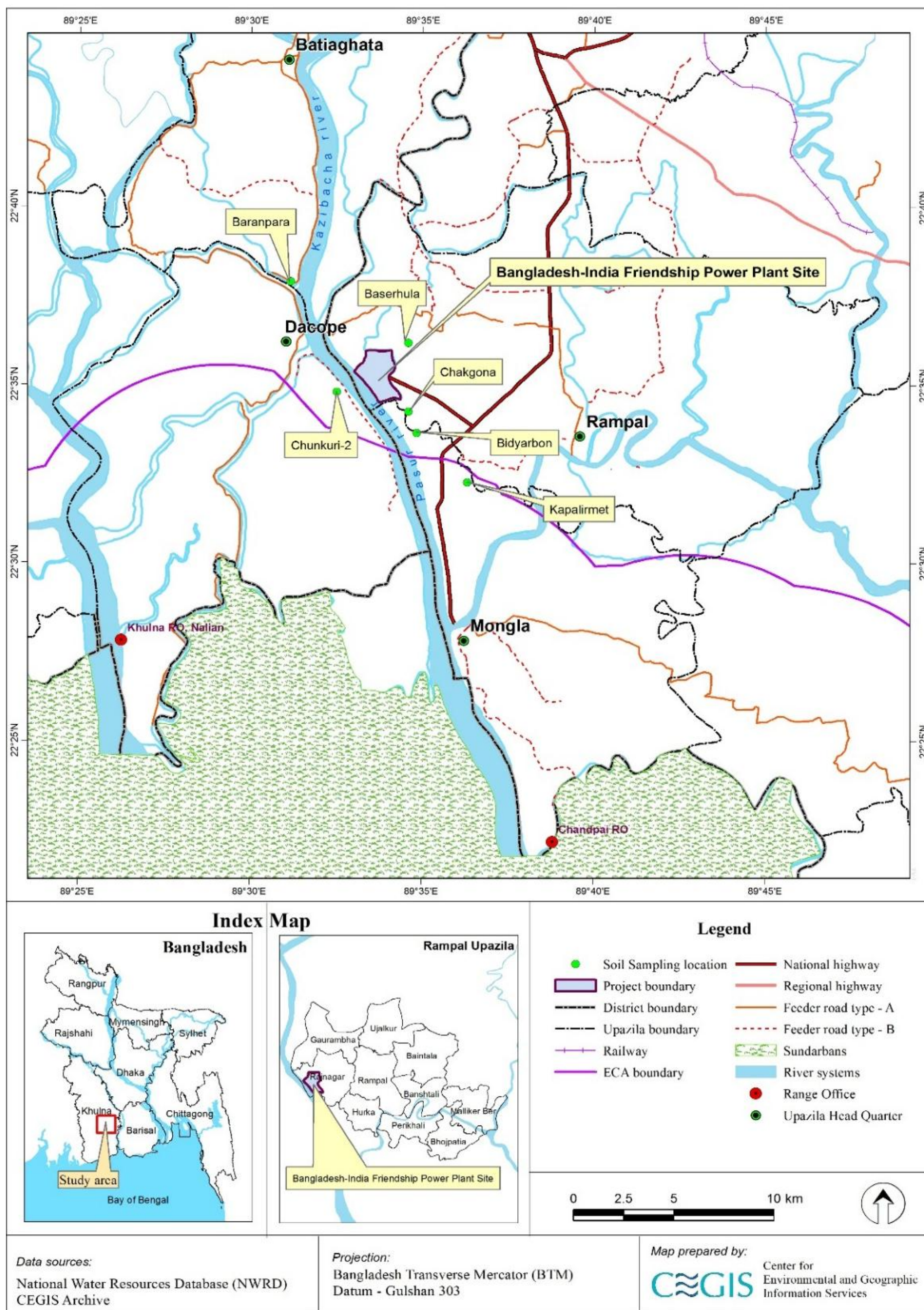


Figure 2.30: Land Resource Monitoring Locations





### 2.9.3 Status of soil quality of monitoring plots

#### *Laboratory Analysis*

Collected soil samples have been handed over to the SRDI, Dhaka for laboratory analysis. The analysis data and report will be incorporated with next monitoring (23rd monitoring) report

### 2.10 Agriculture Resources Monitoring

Monitoring of agriculture resources has been scheduled twice a year as per the monitoring plan of the ToR and accordingly, the survey was conducted in November, 2019. The data on agricultural practice (Production, damage, input use etc.) was collected through informal interview (KII, RRA and FGD) with the local farmers from the monitoring area.

#### *Monitoring Indicators*

For data collection, six sampling plots were selected on random basis within the project influence area during construction phase monitoring. The mauzas which were selected for land resources monitoring were considered for monitoring agricultural resources.

During 22<sup>nd</sup> quarterly visit, consultations and group discussions were organized with local people to know the use of agricultural inputs, present cropping patterns by land type, crop damages and other conditions like drainage congestion/water logging, salinity intrusion or other natural calamities induced impacts, diseases and pest infestation as well as management practices and crop production in the selected locations of the monitoring area.

#### *Present Cropping Patterns of Monitoring Plots*

Detailed data on cropping pattern for this year were obtained through discussions with the plot owners. Based on the discussions, the plot-based cropping patterns was identified and the associated data was collected in November 2019 and described in the following sections and presented in **Figure 2.31 to Figure 2.34**.

#### *Agriculture Plot-1 (Baranpara)*

This plot is located at Baranpara mauza and the area is about 0.4 hectare. During 22<sup>nd</sup> monitoring, the plot was found to be water logged and hence the excess amount of water couldn't be drained out properly from the plot. Therefore, the Local Aman (Chapshail) was cultivated in this plot in Kharif-II season. For this production of Local Aman, no chemical fertilizers and pesticides were applied in this plot. The cropping practice and management practice remain same as the previous monitoring (20<sup>th</sup> monitoring). It was noted that a part of the crop of this plot was damaged due to cyclone "BULBUL". Due to this impact crop production might be reduced. The detailed cropping pattern is shown in **Table E.1 of Appendix IV**.

#### *Agriculture Plot-2 (Chunkuri-2)*

This monitoring plot is located at Chunkuri-2 and the size of the plot is about 0.93 hectare. Local Aman (Benapole) was found to be cultivated in this plot in Kharif-II season. No chemical fertilizers were applied in this plot. The cropping practice and management practice remain same as the previous monitoring (20<sup>th</sup> monitoring). Detailed cropping pattern has been shown in **Table E.1 of Appendix IV**.

### Agriculture Plot-3 (Kapalirnet)

This monitoring plot is located at Kapalirnet and the size of the plot is 0.14 hectare. During the 1<sup>st</sup> monitoring period of pre-construction phase, it was found to be cultivated, but later on, this plot remained fallow from the 2<sup>nd</sup> and 3<sup>rd</sup> monitoring program due to increase in salinity. According to the opinion of the local people, Bangladesh Water Development Board (BWDB) decided to re-excavate the Ghona River and hence they had to remove all the obstacles to facilitate the re-excavation of the Golbunia khal mouth. Then the saline water was allowed to enter into the settlement areas including their cultivated plots during the year 2014-15 and remained inundated by saline water. As a result, farmers started practicing shrimp culture instead of cultivating traditional crops in these plots. However, a number of farmers tried to cultivate crops in their plot in this adverse condition, but all crops were actually damaged due to the above-mentioned fact.

Owners of Shrimp farms of this area used the saline water in these plots for shrimp culture as there was no scope to drain out saline water from this area. The situation is still not in farmers' favour. Farmer of this land decided that they would not cultivate crops in future due to increase in salinity. Rather they would only practice the shrimp culture in future. It was observed during the recent monitoring period that the plot still remained fallow (22<sup>nd</sup> monitoring). Detailed for this plot is presented in **Table E.1 of Appendix IV**.



**Figure 2.31: View of Monitoring plot-2 (Chunkuri-2) at November, 2019**



**Figure 2.32: View of Monitoring plot -3 (Kapalirnet) at November, 2019**



**Figure 2.33: View of Monitoring plot-1 (Baranpara) at November, 2019**



**Figure 2.34: View of Monitoring plot-5 (Baserhula) at November, 2019**

*Agriculture Plot-4 (Chakgona)*

This monitoring plot is located at Chakgona and the size of the plot is 0.14 hectare. In the previous monitoring period, this plot was converted to school cum cyclone shelter instead of agricultural land. So the monitoring plot was shifted to the opposite bank of the river where cropping practice, water logging condition and other local factors are similar to the previous one. Local Aman (Chapsail) was found in the field during field visit where no chemical fertilizer was used (**Table E.1 of Appendix IV**).

*Agriculture Plot-5 (Basherhula)*

This monitoring plot is located in Basherhula and the size of the plot is 0.47 hectare. Local Aman (Chapshail) was found to be cultivated in this plot in Kharif-II. Chemical fertilizer (Urea @ 50kg/plot) and granular pesticides (Basudin @1kg/plot) were reported to be used in the plot. Only Leaf folder was observed in this plot as pest infestation. The cropping practice and management practice remain same as the previous monitoring (20<sup>th</sup> monitoring). However, detailed cropping pattern is shown in **Table E.1 of Appendix IV**.

*Agriculture Plot-6 (Bidyarbon)*

This sampling plot is newly selected for monitoring as per the TOR. The size of the plot is 0.1 ha. Only local Aman (Chapshail) is cultivated in this area during Kharif-II season. Chemical fertilizer and pesticides are not used here. Detailed cropping pattern is shown in Table E.2 of Appendix IV.

**2.11 Crop Production in Monitoring Plots**

The information on crop production were collected after harvesting in April 2020. For this reason, crop production details will be incorporated in April, 2020 report (24<sup>th</sup> monitoring).

**2.12 Crop Damage in Monitoring Plots**

The information on crop damage were collected after harvesting in April 2020. For this reason crop damage details will be incorporated in April, 2020 report (24<sup>th</sup> monitoring).

**2.13 Livestock Resources Monitoring****2.13.1 Methodology***Monitoring Indicators*

The frequency of monitoring for livestock resources data collection was considered twice in a year. During the 22<sup>nd</sup> quarterly visit, consultations and group discussions were organized with local people to know the status of feed/fodder and diseases of livestock in the adjacent of the project area (Baranpara, Chunkuri-2) and study area (Mongla bazar, Bhaga bazar, Rampal). The data on livestock status was collected in November 2019 and described in the following sections.

**2.13.2 Feed/Fodder condition of Livestock Resources**

Feed and fodder condition remain similar to the previous monitoring (20<sup>th</sup> monitoring). During this monitoring, shortage of fodder was reported in two monitoring spots (Chakgona and Basherhula). According to their statement, they started selling cows as area of grazing land was squeezed. The project area was previously used for grazing land, which is completely



confined now. Even the authority (BIFPCL and Forest department), send the cows to jail (*Khoar*) when it enters the confined area. On the other side, Forest department is using the stated land for forestation which is a mandatory issue for power plant or any other infrastructure construction from environmental point of view. To protect the new forest area, they have a right to jail unwanted cows. Under this situation, monthly single cow rearing cost increased up to 1000 BDT which creates an extra burden to the poor farmers and forced them to sell cows.

### **2.13.3 Diseases of Livestock Resources**

Diseases of livestock occurs in every year in the study area. According to the opinion of local people, major bacterial and viral diseases include Peste des Petits Ruminants (PPR), Foot and Mouth Disease (FMD) and Tarka (Anthrax) etc. were observed in the study area. Major poultry diseases were reported as Duck plague, Duck pox, Diarrhoea, Newcastle (Ranikhet), Fowl pox and Fowl cholera etc. The most vulnerable period is considered in between July and November for spreading diseases to livestock and poultry populations. However, some diseases were also reported to be occurred round the year. The severity of the infestation was reported more or less alike in this concurrent circumstance as for the past situations. The mortality rate of the livestock/ poultry is negligible, due to immunization and insemination program run by Department of Livestock

## **2.14 Transportation Monitoring**

### **2.14.1 Location of Traffic Survey**

The traffic survey during the construction phase was conducted from November 13 to 15, 2019 on two week days and one on weekend at three pre-selected locations around the project site. Weather was Sunny during the surveys conducted.

The selected sites were Khudir Bottola and Digraj at Khulna Mongla Road and Ichamoti Bridge at Power Plant access road presented in the **Figure 2.35**.

### **2.14.2 Methodology**

Traffic surveys were carried out at three distinct periods (7:00 AM to 10:00AM; 12:00 PM to 2:00PM; and 17:00 PM to 19:00PM) to understand the nature of traffic flow and traffic load on the preselected locations during different phase of the day. Vehicles were categorized based on the available vehicle type around in the project area.

### **2.14.3 Traffic Volume Calculation**

The survey results were used in computing the traffic volume of these roads in Passenger Car Unit (PCU). PCU is a matrix used in Transportation Engineering, to assess traffic-flow rate on roadways. A PCU is essentially the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car. While calculating the traffic volume in PCU, vehicle conversion factors suggested by the Roads and Highway department of Bangladesh were used as mentioned in **Table 2.10**.

**Table 2.10: Factors Used for PCU Calculation**

Vehicle type	Factor
Bus	2.5
Minibus/Truck	2
Car/Microbus/Zeep	1
CNG	0.5
Rickshaw/Auto Rickshaw	0.8
Tempo/Human hauler	0.6
Motorcycle	0.3
Bicycle	0.2
Push Cart	4

Source: Field Survey, November, 2019

As earlier, vehicular movements observed during the surveys were mostly for the regular construction activities of the Power Plant. Construction activities of the Power Plant are progressing heavily. Traffic volume and traffic nature at all the three surveyed location were similar to earlier monitoring results during the construction period. The detail survey findings regarding the traffic volume surveys as well as the detail calculations are attached in **Table F.1, F.2 and F.3 of Annex-IV**.

## **2.15 Water resources Monitoring Plan**

### **2.15.1 Introduction**

Bangladesh is a land of rivers. Rivers in different regions have different characteristics. Rivers in the northern parts have fluvial characteristics while it is tidal in the southern parts of Bangladesh. Passur River is one of the dynamic and major rivers in the southern parts of Bangladesh. Rampal power plant is being constructed along the left bank of the Passur River. It is always important to monitor the morphological characteristics of the river at regular interval to assess the dynamics of the river in case of any development works. Monitoring of river dynamics like riverbank erosion & erosion and shifting of the bankline of the Passur River with a half-yearly basis may facilitate the proper management and planning of the power plant.

### **2.15.2 Methods to Assess the Riverbank Erosion and Accretion of the Passur River**

For the assessment of the riverbank erosion and accretion, time series satellite images were used. Time series satellite images were processed and analyzed before the assessment and identify the locations of erosion and accretion as well as the shifting of bankline in half yearly period. The steps of images processing and analysis is briefly explained below.

### **2.15.3 Collection and Processing of Images**

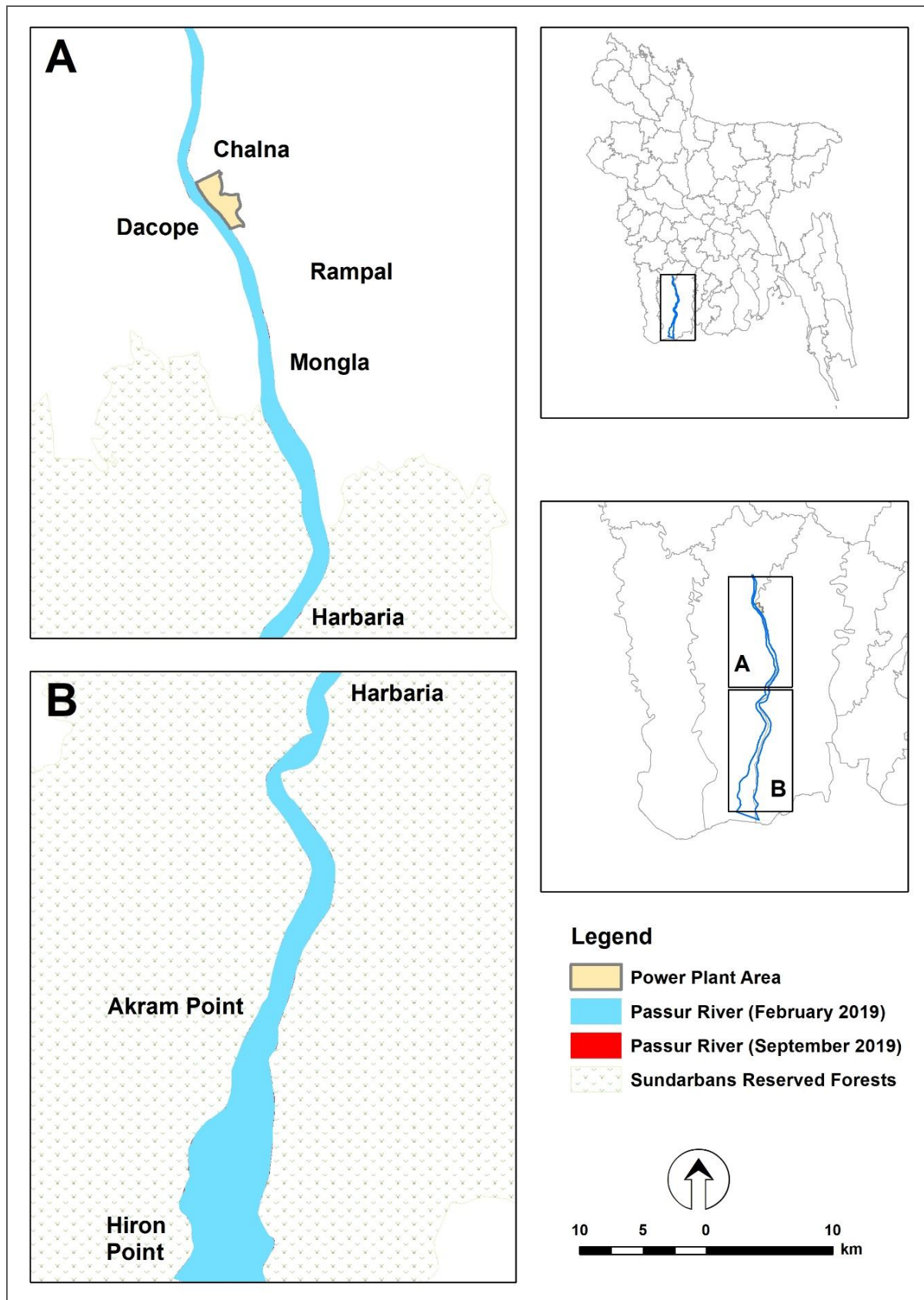
Sentinel-1 Radarsat satellite images having 10m resolution covering the Passur River from Chalna to Hiron Point for the month February 2019 and September 2019 were collected. After that satellite images were geo-referenced to have the same projection system. Then, it was found that one image differs with the other image. In that case, images were co-registered to avoid the distortion with each image.

#### **2.15.4 Delineation of Bankline**

After collection and processing of images, banklines have been delineated of the Passur River for the mentioned period using Arc-GIS tool. Then, banklines have been analyzed and superimposed to assess the erosion-accretion and shifting of the river during period from February 2019 to September 2019.

#### **2.16 Monitoring of Erosion and Accretion**

For monitoring the half yearly riverbank erosion and accretion at the project site, Mongla, Harbaria and Akram point areas, banklines of the Passur River were superimposed with each other. It was found that the river is very stable and there is no riverbank erosion or accretion as the river has not shifted from February 2019 to September 2019 although there are red color in some locations which may be considered as negligible. Hence, there is no bankline shifting of the Passur River along its both banks during its passage from Chalna to Hiron Point (**Figure 2.36**).



**Figure 2.35: Riverbank Erosion and Accretion of the Passur River from February 2019 to September 2019**

## 2.17 Monitoring of Chemical properties of bed materials

### 2.17.1 Methodology

Sediment is considered as an important environmental indicator for metal pollution in any natural ecosystem. The investigation of heavy metals in water and sediments could be used to assess the anthropogenic impacts and risks posed by waste discharges to the riverine ecosystems. Therefore, sediment quality assessment was done during environmental issues monitoring of this project.

#### *Sampling Frequency*

The frequency of monitoring for sediment quality is considered twice in a year (January and July) and accordingly, the sediment sampling was done during 21<sup>st</sup> monitoring (July, 2019).

#### *Monitoring Indicators*

The main objective of sediment quality monitoring is to find out the heavy metal accumulation in sediments due to anthropogenic activities (e.g. power plant activity and coal transportation). To find out the answers, a biannual sediment monitoring was done in different sampling points. The major indicators for monitoring are heavy metals (As, Pb and Hg), pH and Sulphate. The selected heavy metals are mainly found in coal and assumed to pollute the sediment and water system during operation stage of power plant.

#### Location

The sampling locations have been selected in both near project area and inside the Sundarbans. The sampling locations are stated in **Table 2.11**. Locations of collected samples are presented in **Figure 2.36**.

**Table 2.11: Location and Sediment Monitoring Plan**

Site No	Monitoring Indicators	Location	GPS (Decimal Degree)		Sampling Frequency	Methods/ Tools/ Techniques
			Northing	Easting		
1	Heavy metals (Arsenic-As, Mercury-Hg, Lead-Pb); pH and Sulfate (SO <sub>4</sub> )	Project Site	N-22°35'21.2"	E-89°32'53.4"	Bi-yearly (January and July)	In situ field sampling and Laboratory Testing at BCSIR
2		Moidara River	N-22°34'33.4"	E-89°33'38.8"		
3		Mongla Port	N-22°30'57.1"	E-89°35'0.3"		
4		Harbaria	N-22°17'44.2"	E-89°32'53.4"		
5		Akram Point	N-22°01'07.6"	E-89°30'34.4"		



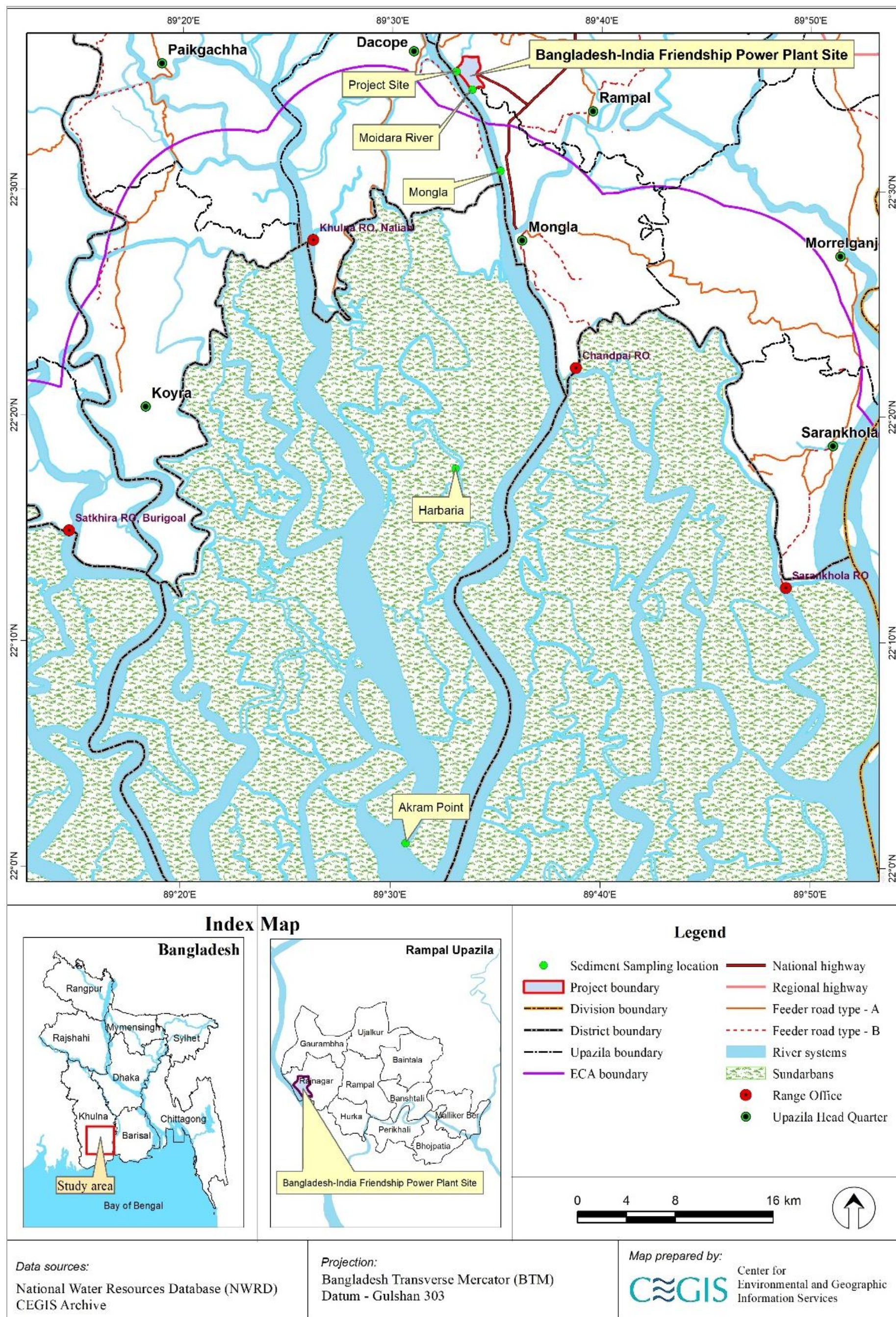


Figure 2.36: Sediment sampling locations





### **2.17.2 Process of Sediment Samples Collection**

#### **2.17.3 Plot Selection**

The sampling locations have been selected on the basis of potential route of coal transshipment and assumed major polluted area. Project site and Moidara River is beside the power plant, while Harbaria and Akram point is inside the Sundarbans area where the coal transportation will take place. The sampling points were selected on the basis of TOR. Expert's judgement was also taken to validate the sampling points.

#### **2.17.4 Sediment Samples Collection**

Standard procedure was maintained during the collection of sediment samples. At least three replications were taken to ensure composite samples. Sediment samples were preserved in air-tight plastic bag for laboratory analysis.

#### **2.17.5 Laboratory Analysis**

Collected sediment samples have been handed over to the Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka for laboratory analysis immediately after 21<sup>st</sup> monitoring and incorporated in this report. The data is presented in **Table 2.12**.

**Table 2.12: Sediment quality monitoring data at different locations of the Passur River**

Monitoring season	Monitoring Parameter	Monitoring Spot-1 (Project site)	Monitoring Spot-2 (Moidhara river)	Monitoring Spot-3 (Mongla Port)	Monitoring Spot-4 (Harbaria)	Monitoring Spot-5 (Akram point)
Wet season,2018	pH	8.61	8.18	8.22	9.06	8.66
	SO4 (mg/kg)	184	297	103	329	277
	As (mg/kg)	5.37	3.65	2.53	4.04	6.18
	Pb (mg/kg)	6.03	6.59	6.05	8.67	8.13
	Hg (mg/kg)	1.38	1.5	1.36	2.08	1.81
Dry season,2019	pH	8.8	8.6	9.25	7.9	8.6
	SO4 (mg/kg)	489	464	264	490	708
	As (mg/kg)	7.51	4.16	4.6	4.1	4.69
	Pb (mg/kg)	8.71	6.52	5.19	5.02	5.67
	Hg (mg/kg)	2.04	3.1	1.77	1.24	1.37
Wet season,2019	pH	8.69	8.73	8.4	8.74	7.4
	SO4 (mg/kg)	200	400	200	400	400
	As (mg/kg)	1	0.78	1	1.08	1.5
	Pb (mg/kg)	7.13	5.45	5.62	8.46	14.6
	Hg (mg/kg)	2.93	2.61	1	7.96	0.45

Source: BCSIR Laboratory analysis

### 2.17.6 Status of sediment quality of the Passur River

The data presented in this report represents wet season, 2019 which was collected in July, 2019 (21<sup>st</sup> monitoring).

According to the analyzed data, only Mercury (Hg) exceed average shale value (**Marowsky and Wedepohl, 1971**) and average upper crust value (**Rudnick and Gao, 2014**). Other two trace element (As and Pb) value found within the stated limits even in published reports (Ali *et al.*, 2018). During this monitoring Arsenic (As) is reduced in all locations than previous wet season monitoring while lead (Pb) concentration increased in project site and Akram point. In case of mercury (Hg) increasing pattern is observed in all locations except Mongla point.

In general, an increasing pattern is towards the sea is observed for As and Pb while Hg shows no specific pattern. The maximum concentration for As and Pb is found in Akram point while in Herbaria Hg scored the most. The average concentration for As, Pb and Hg during this monitoring is 1.07 ppm, 8.25 ppm and 2.99 ppm respectively. In project site (jetty point), concentration of all elements are below this monitoring average. However, an unusual Hg concentration is observed in Harbaria point. Reference level of different metals in sediment of the Passur River is given in the following **Table 2.13**.

**Table 2.13: Reference level of different metals in sediment of the Passur River**

SI No.	Name of Heavy metal	Average upper crust concentration (ppm)	Average Shale Value (ppm)	Average heavy metal content in the Passur River in ppm (Ali <i>et al.</i> , 2018)	
				Summer	Winter
01.	Arsenic (As)	4.8	14	8.87	12.4
02.	Lead (Pb)	17	20	21.9	33.6
03.	Mercury (Hg)	0.05	0.26	-	-





### 3. Biological Environment

Biological resources include all living organisms within an ecosystem which interact with one another as well as with the concerned physical environment. The biological resources around the project site were categorized into three major groups and monitored quarterly with the aim to establish baseline conditions to compare with the probable impact of proposed project in place. These groups include fisheries resources, ecological resources and Sundarbans Reserve Forest (SRF).

#### 3.1 Fisheries Resources

The monitoring of twenty quarters for the session of 2014-15, 2015-16, 2016-17, 2017-18 as well as of 2018-2019 were completed and reported earlier. This chapter contains the findings of 22<sup>nd</sup> quarter and comparison with the earlier twenty-one (21) quarters.

##### *Location of Monitoring Sites*

In this phase, the monitoring activities were carried out in 13 pre-selected locations of which 10 locations were for capture fish habitat and three (03) were for shrimp/fish farms (culture fish habitat). Sampling sites for capture fishery were selected based on the available fishing grounds at upstream, midstream and downstream of the Passur River system. Sampling sites for culture fishery (shrimp/fish farms) were selected considering the project influence area. The fisheries resources monitoring locations are provided in **Table 3.1** and also shown in **Figure 3.1**.

**Table 3.1: The sampling locations for monitoring of fisheries resources**

Site	Capture Habitat Location	Site	Capture Habitat Location
A	Akram Point	F	Jongra
B	Haldikhali	G	Chandpai
C	Charaputia	H	Mongla Port
D	Bagha	I	Maidara
E	Harbaria	J	Chalna Point, Batiaghata
Site	Culture Habitat Location	Site	Culture Habitat Location
1	Bhekatkhali Khal, Rajnagar	3	Chunkuri-2
2	Kapasdanga-Muralia		

##### *Selection of Parameters*

According to ToR, five major components were selected for fisheries monitoring, such as fish habitat status, fish migration, fish diversity, shrimp/fish farm practices and fish production. Fish habitat status was monitored through investigating habitat suitability index in view of habitat classification based on length frequencies of different fish species, sensitivity of fish diversity and survival success of different life stages of fish to abiotic factors (water quality, bed material, morphological aspects and biotic factors (food cover). Fish migration status was monitored through assessing migratory fish species diversity, migration pattern, migration purpose, period and extent of migration etc. Species evenness, species richness and community structure were investigated for monitoring fish diversity. Shrimp/fish farm practice was monitored by viewing stocking pattern, growth rate and mortality rate. Fish production monitoring was divided into capture and shrimp/fish farm production.

### **3.1.1 Methodology**

#### *Fish Habitat Status*

Fish habitat status was monitored through determination of Habitat Suitability Index (HSI) by applying numerical habitat model based on the habitat classification and sensitivity of fish diversity and survival success of different life stages of fish to abiotic and biotic factors. Fish habitat classification was analyzed by calculating Euclidean Distance among sampling sties. Moreover, the similarities in species composition among the sites were analyzed using the Jaccard Index (JI) for estimating the extent of similarity between pairs of data sets.

#### *Fish Migration*

Migratory species were identified from the sampling sites by analyzing the common species found in the catch assessment survey and based on IUCN list.

#### *Fish Diversity*

Fish diversity was surveyed by Catch Per Unit Effort (CPUE) method. The fish individuals were counted according to the length of each species from the samples. Diversity was estimated by analyzing Shannon-Weiner Index ranges from 0 to 1. Fish species richness (FSR) was analyzed using the Simpson's Index that generates two types of values. The first one includes values from 0 to 1 expressing normalization scores for species richness status and the second one includes values from one (01) to values equal to the total number of species found in the sample which suggests that how many species are dominant in this fish community. Fish community structure has also been analyzed through counting the length-wise fish individuals.

#### *Fish-Shrimp Culture Practice*

For monitoring shrimp/fish farm, three farms within the direct impact zone of the proposed Power Plant were surveyed. Stocking pattern of the shrimp/fish farm is the major issue for successful production, because of having natural genetic resources from the wild source of the Passur River System. Moreover, mortality rate should be minimized for getting more economical output from the farms. So, stocking pattern and mortality rate and its causes were surveyed intensively.

#### *Fish Production*

Fish production for riverine fish was surveyed through CPUE. The information on the species-wise production of shrimp/fish farm was collected from the selected farms for the last catch.





Figure 3.1: Fisheries Resources Monitoring Locations







### 3.1.2 Status of monitoring

Followed by the quarter monitoring of the 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19 (up to 21<sup>st</sup> quarter monitoring), 22<sup>nd</sup> quarter monitoring of session 2019-20 was conducted during the period from 1 November to 14 November, 2019. No fishing activities were observed at Akram Point (A), Haldikhali Khal (B), Charaputia (C), Bhodra Khal (D), Harbaria (E) and Jongra Khal (G) during field visit in this quarter monitoring. The reason for not observing fishing activities was stop fishing permit by Department of Forest (DoF), Khulna in the Sundarban area due to *Ras Mela* festival at Dublarchar of Sundarban.

#### *Fish Habitat Status*

Fish habitat status has also varied in the view of habitat classification and habitat use pattern of different life stages of different fish species.

#### Habitat Classification

Habitat classification was analyzed by using the length-wise distribution of different fish species in the sampling sites. The length of different life stages of fish species was identified and evaluated from literature review. Linkage distance was calculated with the similarity in distribution. The entire stretch of the Passur River System consists of three major behavioral habitats. The sampling sites were classified on the basis of abundance of different life stages of fish species in those habitats. The following tables show the classification of seven (07) sampling site for 1 to 15<sup>th</sup> quarter monitoring and ten (10) sampling sites from 16<sup>th</sup> to 21<sup>st</sup> quarter monitoring according to the ToR in respect of habitat uses for previous quarters of fisheries monitoring (**Table 3.2**).

**Table 3.2: Classification of habitat use of 10 sampling sites**

Monitoring Quarter	Type of Habitat Use
1 <sup>st</sup> quarter (April, 2014)	<ul style="list-style-type: none"> <li>• Grazing Ground</li> <li>• Grazing and Breeding Ground</li> </ul>
2 <sup>nd</sup> quarter (July, 2014)	<ul style="list-style-type: none"> <li>• Grazing Ground</li> <li>• Spawning and Nursery Ground</li> </ul>
3 <sup>rd</sup> quarter (October, 2014)	<ul style="list-style-type: none"> <li>• Grazing Ground</li> <li>• Grazing and Breeding Ground</li> <li>• Spawning, Nursery and Grazing Ground</li> </ul>
4 <sup>th</sup> quarter (January, 2015)	<ul style="list-style-type: none"> <li>• Grazing Ground</li> <li>• Grazing and Breeding Ground</li> <li>• Spawning, Nursery and Grazing Ground</li> </ul>
5 <sup>th</sup> quarter (April, 2015)	<ul style="list-style-type: none"> <li>• Grazing Ground</li> <li>• Nursery Ground</li> <li>• Spawning and Nursery</li> </ul>
6 <sup>th</sup> quarter (August, 2015)	<ul style="list-style-type: none"> <li>• Grazing, Breeding Ground</li> <li>• Spawning, and Nursery Ground</li> </ul>
7 <sup>th</sup> quarter (October, 2015)	<ul style="list-style-type: none"> <li>• Grazing Ground,</li> <li>• Nursery Ground and</li> <li>• Growing and Feeding</li> </ul>
8 <sup>th</sup> quarter (January, 2016)	<ul style="list-style-type: none"> <li>• Nursery and Feeding Ground</li> <li>• Growing and Feeding</li> </ul>
9 <sup>th</sup> quarter (April, 2016)	<ul style="list-style-type: none"> <li>• Spawning and Nursery Ground</li> <li>• Feeding and Growing Ground</li> </ul>

Monitoring Quarter	Type of Habitat Use
10 <sup>th</sup> quarter (July, 2016)	<ul style="list-style-type: none"> <li>• Nursery Ground</li> <li>• Feeding and Breeding Ground</li> </ul>
11 <sup>th</sup> quarter (October, 2016)	<ul style="list-style-type: none"> <li>• Breeding and Spawning Ground</li> <li>• Feeding and Grazing Ground</li> </ul>
12 <sup>th</sup> quarter (January, 2017)	<ul style="list-style-type: none"> <li>• Grazing and Spawning Ground</li> <li>• Nursing Ground</li> </ul>
13 <sup>th</sup> quarter (April, 2017)	<ul style="list-style-type: none"> <li>• Grazing and Feeding Ground</li> <li>• Nursing Ground</li> </ul>
14 <sup>th</sup> quarter (October, 2017)	<ul style="list-style-type: none"> <li>• Grazing and Feeding Ground</li> <li>• Nursing Ground</li> </ul>
15 <sup>th</sup> quarter (January, 2018)	<ul style="list-style-type: none"> <li>• Grazing and Feeding Ground</li> <li>• Nursing Ground</li> </ul>
16 <sup>th</sup> quarter (April, 2018)	<ul style="list-style-type: none"> <li>• Feeding ground</li> <li>• Growing ground</li> <li>• Nursing ground</li> </ul>
17 <sup>th</sup> quarter (July, 2018)	<ul style="list-style-type: none"> <li>• Spawning and Nursery Ground</li> <li>• Nursery Ground with Feeding and Growing Capacity</li> <li>• Growing and Feeding Ground</li> <li>• Omni-ground</li> </ul>
18 <sup>th</sup> quarter (November, 2018)	<ul style="list-style-type: none"> <li>• Ground for Maturation</li> <li>• Omni-Ground: Nursery and Feeding Ground/Migratory Route; Ground for Maturation; Growing and Maturation Ground; Maturation Ground for Juveniles</li> </ul>
19 <sup>th</sup> quarter (February, 2019)	<ul style="list-style-type: none"> <li>• Ground for Feeding</li> <li>• Omni-Ground including Nursery Ground and Ground for Maturation</li> </ul>
20 <sup>th</sup> quarter (April, 2019)	<ul style="list-style-type: none"> <li>• Ground for Feeding and Maturation</li> <li>• Omni-Ground including Nursery Ground and Ground for Maturation</li> </ul>
21 <sup>st</sup> (July, 2019)	<ul style="list-style-type: none"> <li>• Ground for Feeding and Maturation</li> <li>• Omni-Ground including Nursery Ground and Ground for Maturation</li> </ul>

During the 22<sup>nd</sup> quarterly monitoring conducted in November of 2019-20 fiscal year, the sampling sites were divided into two major classes and shown in the **Figure-3.2**.

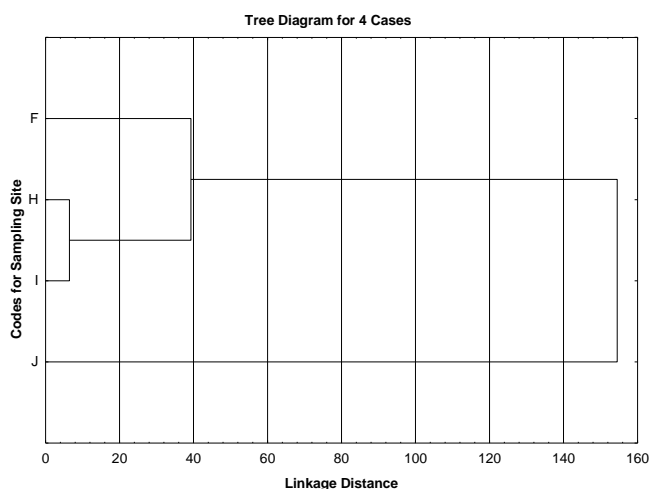
- 1. Spawning and Nursery Ground:** The Chandpai Point was found to support single length groups i.e. <2 cm. It indicates that the mentioned sampling site was found to be used as spawning and nursery ground of observed fish species.
- 2. Omni-Ground:** Another classes, found to support multi-length groups (3-5 cm, 5-10 cm, 10-20 cm and >25 cm length groups) of observed fish species was considered as the omni-ground for fishes. This class was also divided into two major functional habitats - a) Feeding Ground and b) Ground for Maturation.

#### **(a) Nursery Ground**

The catch revealed that availability of Juvenile stage (Length group: 3-5cm and 5-10cm as defined in the methodology) of different fish species were dominant at Chalna Point with little proportion of Mongla Point (H) and Maidara (I). It indicates that these habitats function as feeding ground for various fish species:

### (b) Ground for Maturation and Feeding

The sampling sites, Chalna (J) and Maidara Khal (I) were found to be rich in adult fishes. The length group of 10-20cm and >25cm were dominant in these sites. These sites were thus considered as the ground for maturation in respect of the observed fish species (**Figure 3.2**).

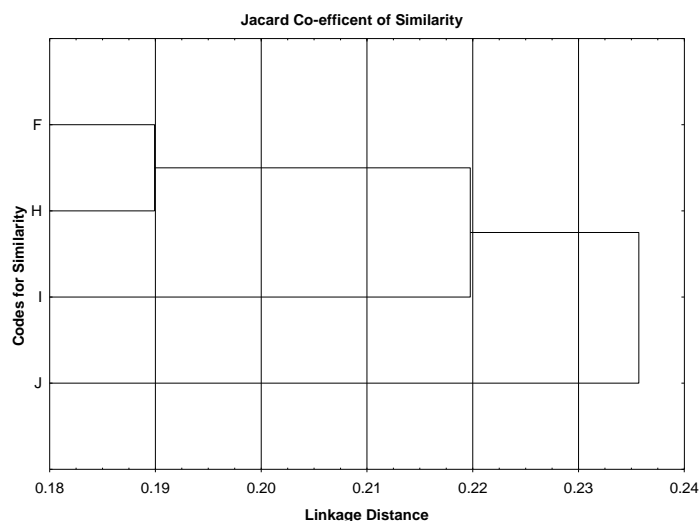


22<sup>nd</sup> Monitoring, November 2019

(Note: Life stages are identified through length measurement of the fish individuals)

**Figure 3.2: Habitat Classification on the basis of different life stages of fish species**

The dendrogram indicated the distances among the JI (Jaccard Coefficient Index) indices which are opposite to the JI values. It was found that the length-wise distribution relationship varied not only with the seasons but also with the year to year. In this quarterly monitoring in 2019-20 (22<sup>nd</sup>), the JI value between the Chandpai Point (F) and Mongla Point (H) sampling sites were the highest (**Figure 3.3**) which indicates the maximum similarity in species occurrence between these two sites out of 4 sampling sites of available fishing.



22<sup>nd</sup> Monitoring, November 2019

**Figure 3.3: Dendrogram showing similarity in binary species composition in four sampling sites**

### Habitat Suitability Index (HSI)

Habitat Suitability Index (HSI) was determined for the year of 2014-15 and 2015-16 considering the exposure to water quality and the production performance of different fish species. Production performance was measured through considering length-structured production assessment model (E. L. Cadima, 2003). Suitability analysis was conducted by applying Iyengar and Sudarshan (1982) developed model. All data was normalized through using UNDP developed normalization equation (UNDP, 2006).

In the first year of monitoring, Sheola khal at Chandpai was found as the most suitable habitat for fish species among the Passur River System. Sheola khal has also been identified as the most suitable in second year which is followed by Harbaria, Akram Point, Haldikhali, Mongla Point, Maidara and Chalna Point (**Table 3.3**). In third year (2016-17) of monitoring, Harbaria Khal was found to be mostly suitable habitat for fish. In 2017-18, the Sheola Khal at Chandpai was highly suitable habitat, which was observed to support various length groups of diversified fishes. In the last monitoring year (2018-19), the Sheola Khal at Chandpai attained again highest suitability index, which indicates that this habitat has the potentiality to support various length groups of diversified fishes.

**Table 3.3: Habitat Suitability Index (HSI) for selected spot in the study area**

Sampling Sites	Location	HSI* (2014-2015)	HIS (2015-2016)	HIS (2016-2017)	HIS (2017-2018)	HIS (2018-2019)
A	Akram Point	0.33	0.56	0.45	0.4	0.35
B	Haldikhali	0.41	0.54	0.51	0.45	0.22
C	Charaputia	-	-	-	0.25	0.31
D	Bhodra	-	-	-	-	-
E	Harbaria	0.23	0.64	0.85	0.6	0.46
F	Chandpai	0.52	0.72	0.81	0.85	0.87
G	Jongra	-	-	-	-	0.18
H	Mongla Point	0.32	0.43	0.45	0.55	0.53
I	Maidara	0.22	0.25	0.35	0.6	0.68
J	Chalna Point	0.22	0.32	0.33	0.42	0.64

\*HSI value is calculated on the basis of life requirement and length-age structured population dynamics model

Note: The HSI will be calculated on the basis of one-year monitoring data

### *Fish Diversity*

#### Shannon-Weiner Index

In this monitoring year of 2019-20, species evenness also varies among the sampling sites. Highest Shannon-Weiner index was found at Chandpai Point (0.81) indicating most evenly distributed fish species. On the contrary, lowest evenness was found at the Chalna Point (0.5) (shown in the **Table 3.4**). It has also been found that both the number of fish species found in in-situ catch and the evenness of their distribution within the sampling sites show high variation with the changing seasonal and yearly bio-physical conditions. The different fish species caught in different catches are shown in **Figure 3.4**.

### Fish Species Richness (FSR)

Fish species richness was identified through Simpson's Index<sup>1</sup>. Considerable difference is noticed in the fish species richness (FSR) in different habitat classes (**Table 3.5 and Table 3.6 and Figure-3.5**).

In this monitoring phase, species richness varies with the sampling sites. Maximum FSR was obtained at Chandpai, Mongla and Maidara site (n=11), while very low FSR was recorded at Chalna Point (n=9). Different scenarios of richness were found in this quarter in comparison to the previous monitoring years. Among habitats in upstream portions of the Passur River, Chalna Point was home to a rich assemblage of Chali Chingri, Maidara River was of Khorsul and Motka Chingri. Among the habitats in midstream portion, Chandpai was rich in Motka Chingri, Mutkura and Bagda Chingri.

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<sup>1</sup>Simpson's index is a method to calculate the community characteristics of fish in a particular habitat. It is mainly used to know about the species richness of a particular habitat to tell how many species are rich in their abundance. The value of this index ranges from 0 to 1. There is other kind of value which is described in the methodology section. The second value is mainly used to measure the species richness in the sampling sites.





**Table 3.4: Site Wise Species Diversity using Shannon–Weiner Index (1<sup>st</sup> to 13<sup>th</sup> QM)**

Site	Species No													Shannon-Weiner Index*												
	1 <sup>st</sup> QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM	13 <sup>th</sup> QM	1 <sup>st</sup> QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM	13 <sup>th</sup> QM
A	33	0	13	7	3	0	10	15	0	0	1	2	2	0.5	0	0.7	0.6	1	-	0.6	0.4	0	0	0	0.9	0.74
B	12	0	24	14	0	0	11	3	0	0	1	0	5	0.9	0	0.6	0.4	0	-	0.6	0.6	0	0	0	0	0.37
C	2	12	9	0	11	26	18	24	17	0	23	10	18	0.3	0.77	0.4	0	0.8	0.6	0.5	0.7	0.6	0	0.6	0.6	0.79
D	12	22	15	26	27	24	20	25	8	19	32	27	15	0.3	0.78	0.7	0.5	0.7	0.7	0.5	0.7	0.6	0.6	0.6	0.8	0.76
E	7	13	10	11	6	16	9	9	15	12	5	4	4	0.4	0.6	0.8	0.8	0.2	0.7	0.9	0.4	0.7	0.5	0.7	0.7	0.51
F	3	13	6	4	10	8	14	6	7	5	7	12	9	0.8	0.77	0.5	0.6	0.7	0.4	0.8	0.7	0.8	0.7	0.9	0.9	0.53
G	6	3	5	7	18	3	8	6	6	4	12	3	15	0.7	0.82	0.7	0.7	0.2	1	0.7	0.8	0.6	0.9	0.2	0.7	0.67

**Table 3.5: Site Wise Species Diversity using Shannon–Weiner Index (14<sup>th</sup> to 22<sup>nd</sup> QM)**

Site	Species Number								Shannon-Weiner Index								22 <sup>nd</sup> QM
	14 <sup>th</sup> QM	15 <sup>th</sup> QM	16 <sup>th</sup> QM	17 <sup>th</sup> QM	18 <sup>th</sup> QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	21 <sup>st</sup> QM	14 <sup>th</sup> QM	15 <sup>th</sup> QM	16 <sup>th</sup> QM	17 <sup>th</sup> QM	18 <sup>th</sup> QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	21 <sup>st</sup> QM	
A	0	0	3	0	8	0	2	0	0	0	0.92	0	0.16	0	0.65	0	0
B	0	0	0	0	2	0	-	0	0	0	0	0	0.92	0	-	0	0
C	0	0	12	0	0	24	11	0	0	0	0.69	0	0	1.69	0.86	0	0
D	0	0	0	0	0	0	-	0	0	0	0	0	0	0	-	0	0
E	0	0	0	17	12	0	2	0	0	0	0	0.31	0.73	0	0.99	0	0
F	6	17	0	0	0	13	22	19	0.85	0.81	0	0	0	1.44	0.74	0.5	0.81
G	81	29	21	16	19	0	26	0	0.62	0.74	0.78	0.85	0.34	0	0.58	0	0
H	112	13	3	18	2	13	-	5	0.54	0.21	0.55	0.49	0	1.44	-	0.14	0.76
I	3	13	12	10	17	11	8	9	0.88	0.33	0.21	0.65	0.85	1.46	0.14	0.52	0.80
J	4	5	10	14	11	21	12	14	0.78	0.32	0.54	0.52	0.52	0.98	0.50	0.71	0.50

\*According to Shannon-Weiner Index, 0-0.30: Low diversity/equally distribution (VH); 0.31-0.50: Moderate Diversity (M); 0.51-0.80: High Diversity (HD) and 0.80-1.0: Very High Diversity (VHD)

**Table 3.6: Site wise Rich Species Number (1<sup>st</sup> to 12<sup>th</sup> QM)**

Site	Location	No. of Rich Species											
		2014-2015				2015-2016				2016-2017			
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>
A	Akram Point	4	0	4	3	3	-	3	2	0	0	1	2
B	Haldikhali	7	0	4	2	0	-	3	2	0	0	1	0
C	Harbaria	1	5	2	0	4	4	3	6	4	0	4	2
D	Chandpai	2	2	5	4	5	8	3	7	4	6	3	7
E	Mongla Point	1	10	4	5	3	6	4	2	4	7	3	2
F	Maidara	3	6	2	2	4	2	4	2	3	2	3	3
G	Chalna Point	3	3	2	3	1	3	3	4	2	4	1	2

**Table 3.7: Site wise Rich Species Number (13<sup>th</sup> to 22<sup>nd</sup> QM)**

Site	Location	No. of Rich Species									
		2017-18			2018-19				2019-20		
		13 <sup>th</sup>	14 <sup>th</sup>	15 <sup>th</sup>	16 <sup>th</sup>	17 <sup>th</sup>	18 <sup>th</sup>	19 <sup>th</sup>	20 <sup>th</sup>	21 <sup>st</sup>	22 <sup>nd</sup>
A	Akram Point	2	0	0	4	0	1	0	2	0	0
B	Haldikhali	1	0	0	0	0	3	0	-	0	0
C	Charaputia	0	0	0	4	0	0	4	7	0	0
D	Bhodra	0	0	0	0	0	0	0	-	0	0
E	Harbaria	7	6	6	0	2	4	0	2	0	0
F	Chandpai	6	5	7	11	9	2	3	7	4	6
G	Jongra	0	0	0	0	0	0	0	3	0	0
H	Mongla Point	2	2	1	2	3	0	3	-	1	5
I	Maidara	1	3	2	1	3	9	3	1	1	6
J	Chalna Point	4	2	1	2	3	2	2	2	3	2

Source: CEGIS Field Survey, April 2014-November 2019

**Pangas****Chitra**



Hilsa



Poa



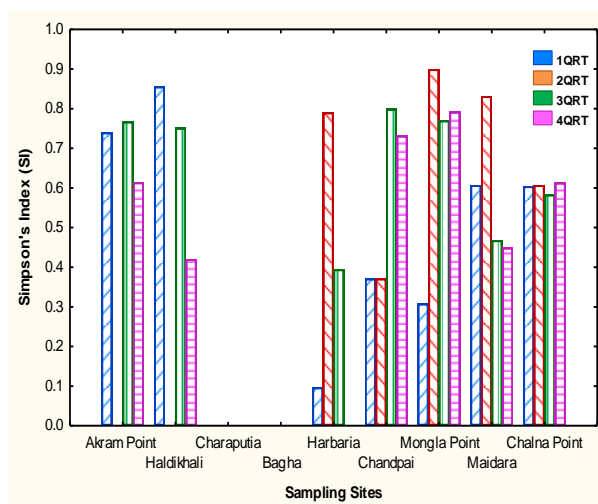
Mix



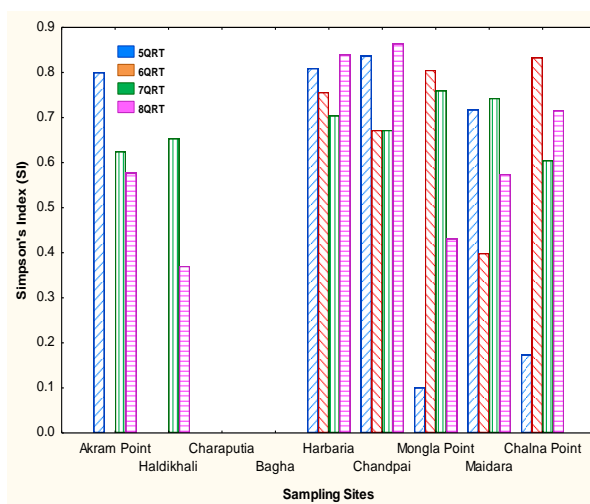
Gharua

Source: CEGIS Field Survey, November 2019

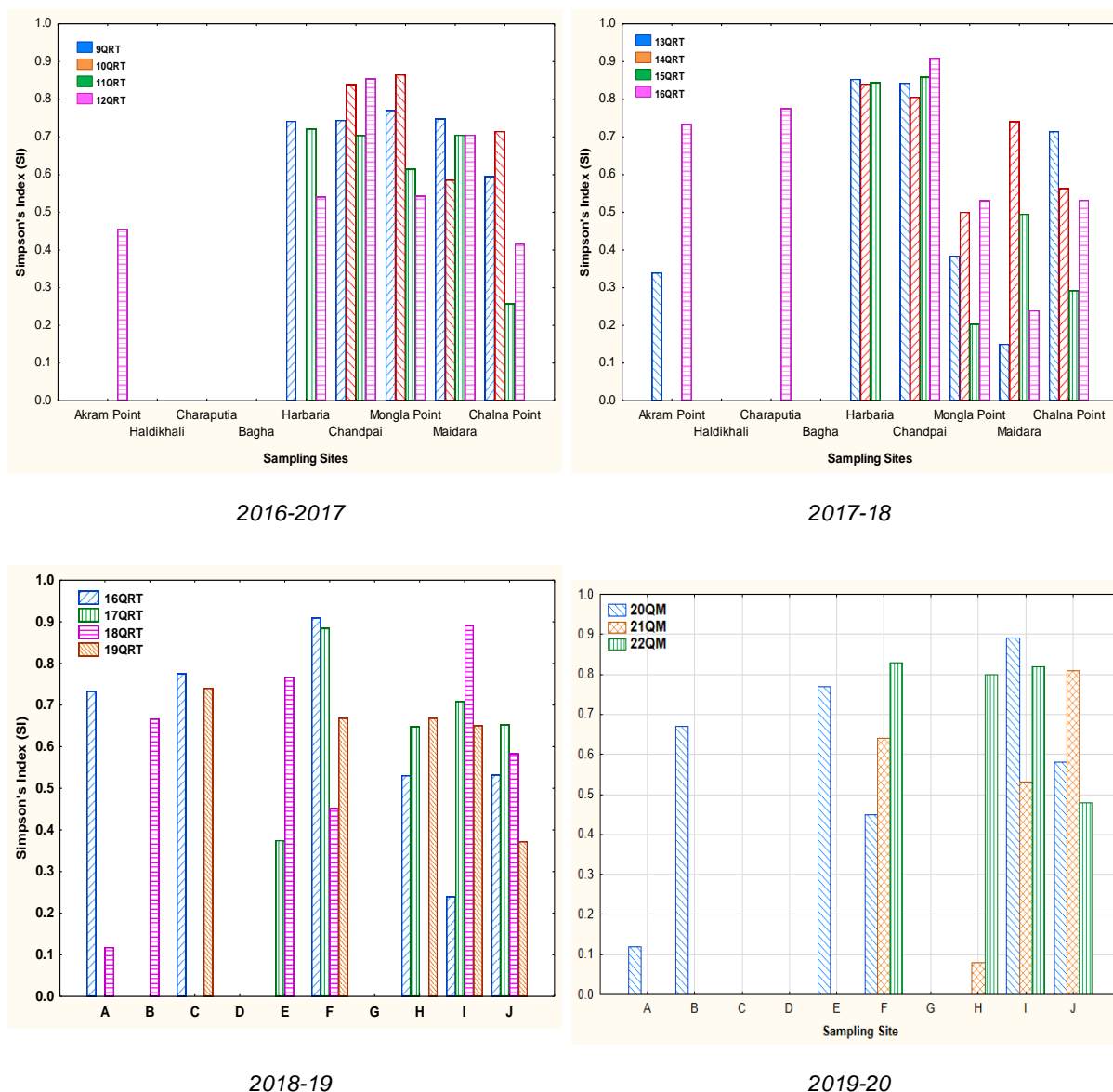
**Figure 3.4: Different available observed fish species in 22<sup>nd</sup> quarter monitoring**



2014-2015



2015-2016



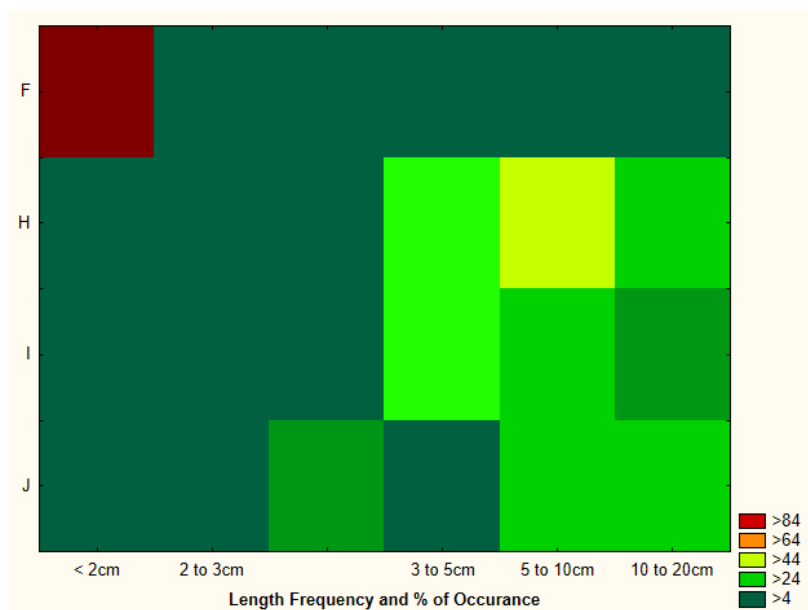
(FSR is identified through Simpson's Index)

**Figure 3.5: Site-wise fish species richness (FSR) in the Passur River System**

### Fish Community Structure

Fish community structure was analyzed through counting the length-wise fish individuals (Figure 3.6). The Table D.2 and D.3 of Appendix IV and Figure 3.6 for 22<sup>nd</sup> quarter of monitoring year of 2019-20 shows that fries were dominant at Chandpai Point and juvenile to adult age group at Mongla, Maidhara and Chalna Point. The catch revealed that among the fishes Bagda Chingri, Chali Chingri, Motka Chingri, Mutkura were dominant in the four sampling sites.





22<sup>nd</sup> Monitoring, November, 2019

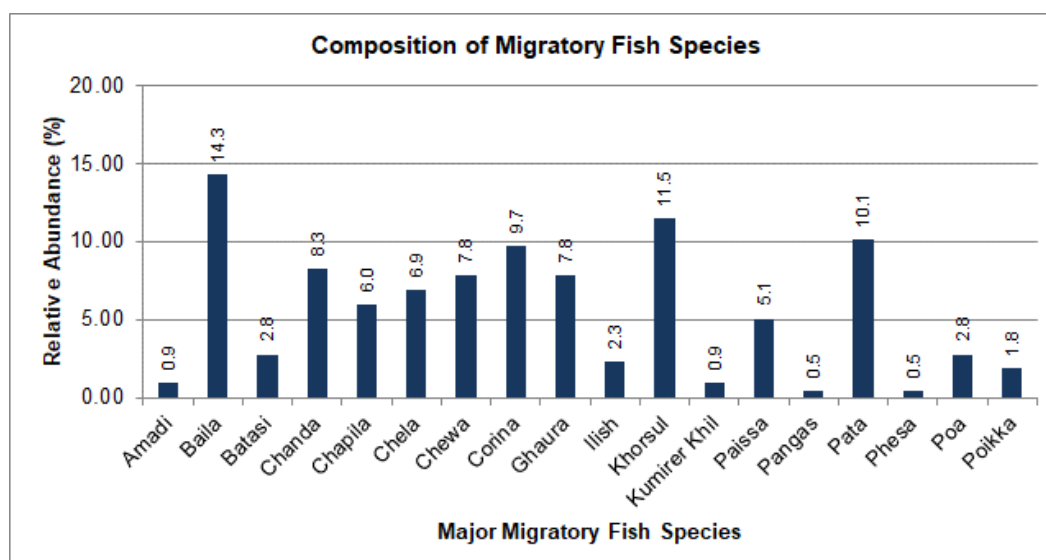
**Figure 3.6: Habitat Distribution of Different Life Stages of Fish Species**

Note: N.B.: Colour ranges from deepest green to deepest red. 0-4.99% Occurrence signifies Deepest Green; 5-9.99%-Shaded Green; 11-14.99%-Normal Green; 15-19.99%-Light Green; 20-24.99%; 25-29.99%-Lightest Green; 30-34.99%; 35-39.99%; 40-44.99; 45-49.99; 50-54.99-Light Magenta; 55-59.99-Deep Magenta; 60-64.99%; 65-69.99%; 70-74.99%; 75-79.99%-Light Red; 80-84.99%-Deep Red; 85-89.99%; 90-94.99%; 95-100%-Deepest Red

### *Fish Migration*

#### Migratory Species Diversity

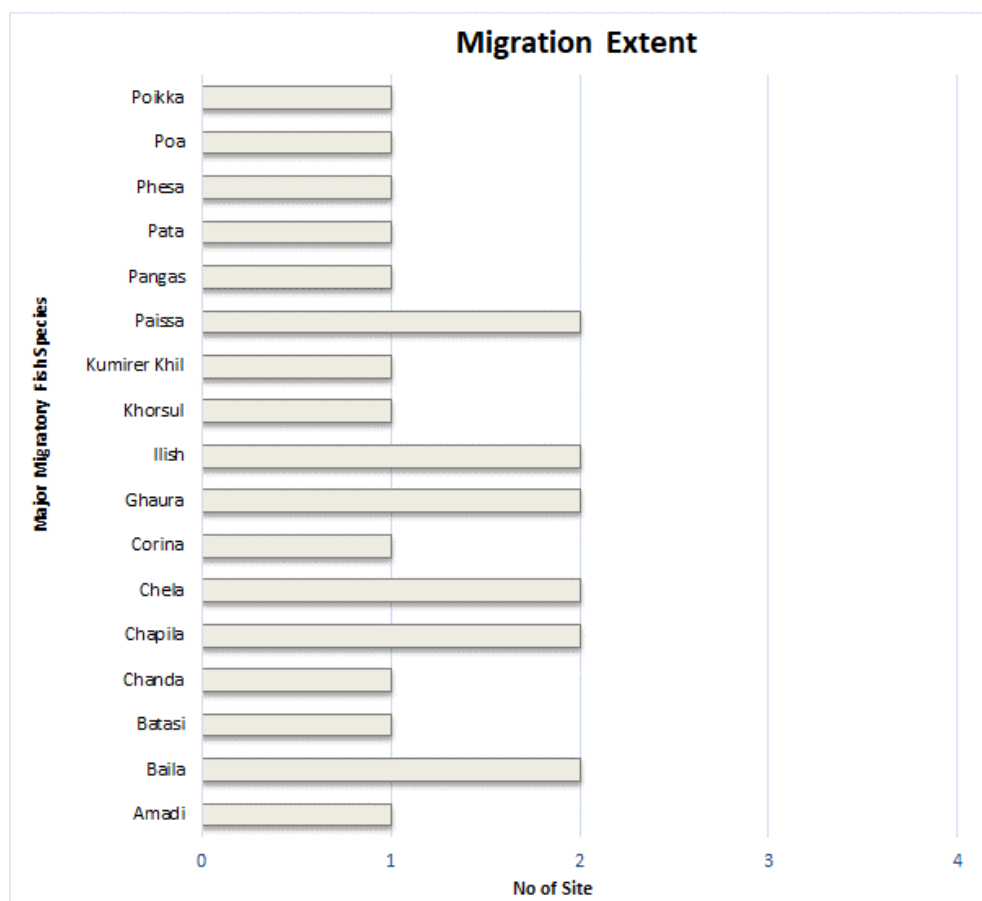
Migratory species were identified by analyzing the common species available in the regular catch from the sampling sites. Fish species like *Baila* attain the maximum abundance among the migratory fish species observed in the 22<sup>nd</sup> quarter of monitoring year, 2019-20. The relative abundance of the migratory species is given below in the **Figure 3.7**.



**Figure 3.7: Relative abundance of major migratory fish species in sampling sites**

### Migration Extent, Time and Purpose

Major fish species showed interesting pattern in distribution for exploiting different purposes mentioned in the following table all along the sampling sites. Among migratory species, Paissa, Ilish, Gharua, Chela and Chapila were observed to migrate long distance (**Figure 3.8 and Table D.4 of Appendix IV**).



**Figure 3.8: Migration extent of major migratory fish species in sampling sites**

### *Shrimp/Fish Farm*

Three farms situated in the direct impact zone of Power Plant were surveyed for monitoring shrimp/fish. Stocking pattern of the shrimp/fish farm is one of the major issues for successful production because of having natural genetic resources from the wild source of the Passur River System. Moreover, maximization of growth rate and minimization of mortality rate should be ensured for getting more economical output from the farms. So, stocking pattern, growth rate and mortality rate and its causes were surveyed intensively.

### *Stocking Pattern*

It is reported by the farmers of the shrimp farms that fish stocking was not done during this monitoring period because this time was mainly harvesting period.

### *Shrimp/Fish Growth Rate and Mortality*

During the 22<sup>nd</sup> quarter of monitoring, the highest growth rate has been observed in the Kapasdanga Gher. (**Table 3.8 and Table 3.9**)

Table 3.8: Growth Rate and Mortality of Fish/Shrimp (1<sup>st</sup> to 13<sup>th</sup> QM)

Gher No.	1 <sup>st</sup> QM (Apr 2014)		2 <sup>nd</sup> QM (Jul 2014)		3 <sup>rd</sup> QM (Oct 2014)		4 <sup>th</sup> QM (Jan 2015)		5 <sup>th</sup> QM (Apr 2015)		6 <sup>th</sup> QM (Aug 2015)		7 <sup>th</sup> QM (Oct 2015)		8 <sup>th</sup> QM (Jan 2016)		9 <sup>th</sup> QM		10 <sup>th</sup> QM		11 <sup>th</sup> QM		12 <sup>th</sup> QM		13 <sup>th</sup> QM	
	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)
1	0.3	15-20	0.2	40	0.25	50	-	-	-	30	0.18	25	0.20	60	-	-	-	-	0.2	20	0.20	60	-	-	-	30
2	0.3	30-35	0.3	94	0.25	10	-	-	-	-	0.14	20	0.15	100	-	-	0.21	15	0.3	40	0.25	50	-	-	-	10
3	0.2	25-30	0.2	25	0.20	65	-	-	-	10	0.15	50	0.25	20	-	-	0.17	30	0.15	30	0.20	30	-	-	-	25

Table 3.9: Growth Rate and Mortality of Fish/Shrimp (14<sup>th</sup> to 22<sup>nd</sup> QM)

Gher No.	14 <sup>th</sup> QM		15 <sup>th</sup> QM		16 <sup>th</sup> QM		17 <sup>th</sup> QM		18 <sup>th</sup> QM		19 <sup>th</sup> QM		20 <sup>th</sup> QM		21 <sup>st</sup> QM		22 <sup>nd</sup> QM	
	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)	Growth Rate (cm/day)	Mortality (%)
1	0.03	50	-	-	0.28	0.28	0.38	80	-	-	-	-	0.35	50	0.38	-	0.35	
2	0.38	35	-	-	0.42	0.42	0.30	70	0.30	80	-	-	0.45	80	0.44	-	0.45	
3	0.02	25	-	-	0.4	0.4	0.20	50	-	-	-	-	0.34	40	0.36	-	0.37	

Source: CEGIS Field Survey, 2014, 2015, 2016, 2017 &amp; 2018

## Fish Production

Capture Fish Production

In 22<sup>nd</sup> quarter monitoring, the highest productivity was found at Maidara Point and the lowest productivity was at Mongla Point (**Table 3.10**). The Chandpai Point was observed mainly to be used for fry collection and fries found in catch was not considered in the productivity assessment. Fishing is shown in **Figure 3.9**.

The present study revealed that the highest catch susceptibility was also found in case of Ilish Jal (0.8 kg/haul) (**Table 3.11**). The following table also expresses that Ilish Jal was mostly used in upper reaches in the Passur River System.

**Table 3.10: Total Catch in Different Gears in the Sampling Sites**

Site	Habitat	Gear Name/Type	Haul Duration (hr)	No of Haul	kg/haul
A	Confluence at Akram Point	Not Found	-	-	-
B	Haldikhali Khal	Not Found	-	-	-
C	Charaputia Khal	Not Found	-	-	-
D	Bhodra Confluence	Not Found	-	-	-
E	Harbaria Khal	Not Found	-	-	-
F	Passur River	Net Jal	1.0	1	-
G	Passur-Jongra Confluence	Not Found	-	-	-
H	Passur-Mongla Confluence	Khepla Jal	0.2	10	0.02
I	Passur-Maidara Confluence	Bepdi Jal	6.0	2	0.5
		Ilish Jal	1.0	2	0.8
J	Passur River, Chalna Point	Ber jal	1.0	1	0.6
		Ilish Jal	1.0	1	0.2

Source: Catch assessment survey, CEGIS, November, 2019

\*\* Weight of Fry is not considered for catch assessment

**Table 3.11: Total Catch in the Sampling Sites (From 1<sup>st</sup> to 13<sup>th</sup> QM)**

Sampling Site	Total Catch (kg)												
	1 <sup>st</sup> QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM	13 <sup>th</sup> QM
A	28	0	3	28.7	6	0	20	276.2	0	0	10	2	2
B	65	0	1	3.3	0	0	10	12.8	0	0	4	0	0.25
C	1,559	0.5	8	8.7	1.05	0.33	19.5	173.6	2.8	0	2.6	10	8.13
D	0	12	3	30	10.5	5.08	10.75	189	0	12	18	56	77.5
E	0	0.6	5	0	0.5	0.4	0.6	7.8	5	7.5	2.6	0	0
F	0	1.2	13	3.7	1.5	0.7	0.8	0	1.5	0.8	0.5	0	0.3
G	0	1.6	4	0.7	2.9	0.83	0.825	70	1	0.8	0.1	0	0.12

**Table 3.12: Total Catch in the Sampling Sites (From 14<sup>th</sup> to 22<sup>nd</sup> QM)**

Sampling Site	Total Catch (kg)								
	14 <sup>th</sup> QM	15 <sup>th</sup> QM	16 <sup>th</sup> QM	17 <sup>th</sup> QM	18 <sup>th</sup> QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	21 <sup>st</sup> QM	22 <sup>nd</sup> QM
A	0	0	17	0	16	0	0.40	0	0
B	0	0	0	0	1	0	0.00	0	0
C	0	0	1.50	0	0	93	17.50	0	0
D	0	0	0	0	0	0	0.00	0	0

Sampling Site	Total Catch (kg)								
	14 <sup>th</sup> QM	15 <sup>th</sup> QM	16 <sup>th</sup> QM	17 <sup>th</sup> QM	18 <sup>th</sup> QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	21 <sup>st</sup> QM	22 <sup>nd</sup> QM
E	1.5	2.56	0	0.1	2	0	0.50	0	0
F	0	0	0	0	0	0	0.00	0	0
G	10.5	37.67	3	4	27	0	0.00	0	0
H	0	0	0.33	22	0	5	0.00	11.5	0.2
I	0.4	0.67	0.13	3	5	1.2	0.00	0.5	1.7
J	0.3	0	1	0.25	1.2	0.6	0.17	1.6	0.8

\*Average Weight 0.15kg/mud crab and average weight 0.6 kg/mud eel

\*\* Weight of Fry is not considered for catch assessment



**Figure 3.9: Fishing gears and crafts used in fishing at sampling sites**

### Culture Fish Production

The present study on shrimp/fish farm in the 22<sup>nd</sup> quarter monitoring phase showed that the highest production was observed in the Gher of Kapashdanga (**Table D-5, Annex-XX**).



## 3.2 Monitoring of Ecosystem and Bio-diversity

### 3.2.1 Indicators Selection

Indicators for terrestrial and aquatic ecosystems have been selected by prior anticipation of probable impacts on ecological resources in different phases of the proposed project.

Composition and diversity of flora is important for vegetation study which indicates vegetation structure of an area. Plant health is directly related with biomass productivity. Plant health of an area may change for changing of different environmental parameters like temperature, composition of gaseous components, soil salinity, humidity and nutrients, air particulate dust etc. Plant diseases and proportion of healthy/ unhealthy plant is needed to observe for ensuring plant health condition.

Canopy status of terrestrial vegetation indicates plant health and biomass properties of an area. Vegetation canopy structure may be change for change of plant growth rate due to soil properties change, plant physiological disorders due to change of climatic parameters or even for different human interventions. To monitor vegetation canopy status of the study area, canopy cover has been followed in different time intervals.

Among the terrestrial faunal community, Bird is an important class that is sensitive to their habitat condition. Changes of environmental parameters, landuse and vegetation composition directly impact on bird's habitat of a locality. Broadly, two types of bird are found in an area; local and migratory. To observe local bird habitat suitability, number of bird nest and nesting bird species can be a good indicator. Numbers of wetlands where migratory birds come in each migration season have also been considered to observing migratory bird habitat suitability of the area.

In the respects of aquatic ecosystems, dolphin is an ecological indicator which indicates water quality as well as aquatic habitat suitability. This aquatic mammal is still present all the river systems of the study area. Any changes of water quality and river bed siltation may change dolphin occurrence in a river system. So, dolphin occurrence is needed to monitor for this study.

### 3.2.2 Rationales for selection of locations

4 homesteads have been selected for monitoring terrestrial ecosystem's indicators of the study area. Locations of the homesteads have been selected considering wind direction and spatial distribution from the project boundary. All the selected locations for terrestrial ecosystem monitoring is at northern sites as maximum time of the wind rose south to north direction and anticipated impacts will be take part according to this area. Beside this, Sundarban Reserve Forest is located sum of 14 km south from the project and various indicators of different locations of this forest is also observing for forest health monitoring. So, no site has been selected at south site of the proposed project.

### 3.2.3 Terrestrial Ecosystem

Terrestrial ecosystem supports most of the floral and faunal communities which are directly related to the environmental parameters like temperatures, air quality, sunlight, soil nutrients etc. In the study area, homesteads occupy maximum portions of terrestrial ecosystems. As such, observation on different indicators of selected homestead vegetation and dweller wildlife will be helpful to know the ecological impacts for the proposed project.

### *Description of the selected homestead*

The homestead in Rajnagar is located at 2.5 km. east from upper North-east boundary of the project site. This is situated inside the damp area as numerous small swamps exist inside and surround the homesteads. Water retention capacity of surface soil of this homestead is very low and for this reason very little number of grasses and other herbs are present. Land elevation of selected homestead at Kalekarber village is comparatively flood free. This is located at about 1.8 km. east from Middle-east boundary of the project. Chalkghona village is located about 0.5 km south from south-east boundary of the project. The selected homestead of this village is close to Maidara River to its north side and saline water shrimp farms to its south periphery. Presence of shallow ditches and peripheral waterbodies support to grow staple coverage of saline tolerant plant species. Borni village is located at about 3.0 km north from north-east boundary. Sampled homestead at Borni is situated at the middle part of the village. This homestead is also dominated by planted tree species and soil condition is similar to Rajnagar site. Vegetation of this homestead have been severely been damaged by past Cyclone Aila.

### *Species Composition of selected homestead vegetation*

#### Homestead at Rajnagar

This homestead is dominated by Gewa (*Excoecaria agallocha*) among all the trees due to its highest population which get favor from soil's salinity for luxurious succession. Beside this, Safeda (*Manilkara zapota*) and Boro ( *Zizyphus* sp) are the two species of fruit yielding trees. Monocots fruits including Narikel (*Cocos nucifera*) and Khejur (*Phoenix sylvestris*) occupied the top canopy of the vegetation. In addition, a number of Bola (*Hibiscus tiliaceus*), Kewra (*Sonneratia apetala*) and one Sundari (*Heritiera fomes*) also found to exist. The homestead very few grasses or undergrowth vegetation.

#### Homestead at Kalekarber dighi

Two species like Narikel (*Cocos nucifera*) and Khejur (*Phoenix sylvestris*) occupies the top canopy. The homestead has many Mahagoni (*Swietenia mahagoni*) saplings which population is also high. Jaam (*Syngium cumini*), Tentul (*Tamarindus indica*), Aam (*Mangifera indica*), Safeda (*Manilkara zapota*), Peyara (*Psidium guajava*) and Boro ( *Zizyphus* sp) are common trees height not more than 7 m. Mahagoni (*Swietenia mahagoni*), Rendi Koroi (*Albizia saman*) and Raj Koroi (*A. richardiana*) are timber trees those are occupied top canopy height more than 10m. Beside this, Neem (*Azadirachta indica*), Bakul (*Mimusops elengii*) and few number of Kola (*Musa* sp) are found on these homestead platforms.

#### Homestead at Chalkghona

Vegetation of this homestead also have rich population of mangrove plant species like Gewa (*Excoecaria agallocha*), Gol (*Nipa fruticans*), Kewra (*Sonneratia apetala*), and Ora (*Sonneratia caseolaris*). Narikel is the dominating tree species as well as occupying the top canopy. As the homestead is near the peripheries of river and shrimp gher, soil salinity supports luxurious growth of mangrove plant. This homestead has two shallow ditches which contain brackish water throughout the year. A number of ornamental plants also observed on this homestead platform.

Homestead at Barni

Rendi Koroï (*Albizia saman*), Mahagoni (*Swietenia mahagoni*), Taal (*Borassus flabellifer*), Narikel (*Cocos nucifera*), Khejur (*Phoenix sylvestris*) are referable. The home owner have planted many fruit yielding trees which is now in sapling form. Among this, Kotbel (*Limonia acidissima*), Aam (*Mangifera indica*) and Safeda (*Manilkara zapota*) are common. Gewa (*Excoecaria agallocha*) was dominated at western part of this homestead now being less populated due to fell by the house owner. Tiger Fern (*Acrostichum aureum*) is a mangrove herb which presence at here also referable.

Random quadrature vegetation survey has been conducted at selected homesteads during recent monitoring tier. A total of 52 plant species (excluding undergrowths) has been recorded from 16 number of surveyed sample quadrates. Details of the survey result is presented in **Table 3.13** below-

Table 3.13: Species composition of the sampled homesteads

Species Name	Local Name	Rajnagar				Borni				Kalekarber				Chalkghona				Total Number of individuals	Biodiversity Index
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16		
<i>Heritiera fomes</i>	Sundari						2		1									3	2.78
<i>Excoecaria agallocha</i>	Tiger Fern					6	8	8	11			7	1					41	
<i>Albizia richardiana</i>	Chambol									3		2	4					9	
<i>Albizia saman</i>	Rendi Koroi				1	2	4	1		1				2	1	1		13	
<i>Anthocephalus sp</i>	Sitki						1											1	
<i>Apanomixys polistachya</i>	Rhyna								4		1							5	
<i>Areca catechu</i>	Supari						1	1	4		2							8	
<i>Azadirachta indica</i>	Neem		2							1	2	3	1					9	
<i>Bombax ceiba</i>	Shimul														2			2	
<i>Borassus flabeliffer</i>	Taal					2		1		3		4						10	
<i>Citrus medica</i>	Lebu														2			2	
<i>Cocos nucifera</i>	Narikel	2	1	1		2		2		3	3	5	6	2	5		2	34	
<i>Colocasia esculenta</i>	Mankochu						3											3	
<i>Cordia dichotoma</i>	Bohal													2				2	
<i>Dentella repens</i>	Danton													1				1	
<i>Diospyros pregrina</i>	Gaab									1				1				2	
<i>Emblica officinalis</i>	Amloki							1										1	
<i>Erythrina ovalifolia</i>	Mandar														1			1	
<i>Excoecaria agallocha</i>	Sundari	4		2	6	6		3	7					3		6	5	42	
<i>Ficus benamina</i>	Jogadumur					1		1										2	
<i>Ficus hispida</i>	Dumur												2					2	
<i>Ficus religiosa</i>	Aswath												1					1	
<i>Heritiera fomes</i>	Gewa	3	-															3	
<i>Hibiscus tiliaceus</i>	Bola					3			2									5	
<i>Hibiscus tiliaceus</i>	Bola											3	2					5	
<i>Ipomoea fistulosa</i>	Dhol Kolmi					3		2										5	
<i>Lawsonia inermis</i>	Mehedi				1			1										2	
<i>Lepisanthes</i>	Amjum/	2	-															2	

Species Name	Local Name	Rajnagar				Borni				Kalekarber				Chalkghona				Total Number of individuals	Biodiversity Index
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16		
<i>rubiginosa</i>	Baraharina																		
<i>Limonia acidissima</i>	Kotbel					1												1	
<i>Mangifera indica</i>	Aam					2	5								3			10	
<i>Manilkara zapota</i>	Safeda			1	1	1				1						2		6	
<i>Mimusops elengii</i>	Bokul					1					1							2	
<i>Moringa oleifera</i>	Sazna												1					1	
<i>Moringa oleifera</i>	Sazna														2			2	
<i>Musa sp</i>	Kola					9	4			11					5			29	
<i>Nipa fruticans</i>	Golpata															2		2	
<i>Pandanus sp</i>	Keya Kanta	6	2	2	-													10	
<i>Phoenix sylvestris</i>	Khejur	2	3	1	2							14	6		1	2	1	32	
<i>Phyllanthus reticulatus</i>	Sitki											30						30	
<i>Phyllanthus acidus</i>	Orboroi				1					1				2				4	
<i>Pongamia pinnata</i>	Koroach				1				1					2				4	
<i>Psidium guajava</i>	Peyara	2			1	2									6			11	
<i>Punica granatum</i>	Bedana				1	1			1						1			4	
<i>Sonneratia apetala</i>	Kewra				1													1	
<i>Swietenia mahagoni</i>	Mahagoni					4		1	1	5	3	8		6	2	2	5	37	
<i>Syzygium cumini</i>	Jaam		1				1							1	3	2		8	
<i>Syzygium samarangense</i>	Jamrul	2			1													3	
<i>Tamarindus indica</i>	Tentul														1			1	
<i>Terminalia arjuna</i>	Arjun													1	1			2	
<i>Terminalia catapa</i>	Kathbadam						2	1							1			4	
<i>Zizyphus sp</i>	Kul boroi														1		1	2	

Source: CEGIS field survey



### Plant health

Structure of vegetation community of this area is tree dominant. Random saline water shrimp farming is a big threat to plant health of this area. Hence, Plant health of this area is not satisfactory. Expansion of shrimp farming in this area triggered increment of salinity of soils. For this reason, overall plant succession, growth and productivity have changed day by day.

#### Plant Diseases and symptoms in homestead vegetation

Plant diseases observation of an area is needed to evaluate plant health and productivity. During initial field survey, some tree species were selected for regular observation of plant disease. In this regards, a number of common tree species have been observed in each homesteads.

Leaf spot, lethal yellowing, leaf blast, nut fall, Mite damage on nut fruit are common diseases of the plants in the study area. A brief discussion was held with home owners about diseases of selected economic plants which exist in their homesteads. Most symptoms for plant diseases are descriptive. Although, all plant diseases symptoms are not visible in a same time of the year, but it was tried to observe the existing disease symptoms. Leaf spot and mite damage on fruits is the common symptoms of *Cocos nucifera*. In addition, bud/trunk rot (Heart Rot), lethal yellowing and diameter loss at top portion of this monocot is also common symptom of this plant in all location. Infection of fungal/bacterial is not remarkable all the homesteads. But Leaf Anthracnose on *Mangifera indica* and Bacteriosis on *Psidium guajava* is commonly found most of the trees. *Phoenix sylvestris* also found unhealthy due to leaf yellowing from manganese deficiency (**Figure 3.10**).



**Figure 3.10: Plant Disease and symptoms in homestead vegetation**

#### Number of diseases affected trees

There is no change in plant health comparing to previous monitoring but improved compare to same season monitoring in November 2018. All the cases, monocots like Coconut (*Cocos nucifera*) and Date Palm (*Phoenix sylvestris*) are the main affected species. A total of 3 coconut and 3 date palm plants were affected at Rajnagar site. Except the disease-affected monocots, other plants are in green and healthy. In the case of Chalkghona, 4 Coconut, 2 Date Palm recorded unhealthy which were suffering from lethal leaf yellowing and top diameter loss from last two years. A total 7 Coconut plant have been affected by top diameter loss and stem rot diseases. However, comparing the November 2018 monitoring, the plant health has improved this year due to reduce salinity and saline water saturation at homestead platforms for improvement of drainage systems by functioning the tidal canals flow beside the homesteads specially at Rajnagar. The Following table represents the proportion of healthy and unhealthy plants in studied homesteads. (**Table 3.14**).

Table 3.14: Number of healthy and unhealthy plants in studied homesteads

Location	Plant Name	Total No. of Plant	No. of Unhealthy Plant																	
			Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan, 2015	Oct, 2016	Jan, 2017	Jan, 2018	Apr, 2018	Jul, 2018	Nov, 2018	Feb 2019	Apr, 2019	Jul, 2019	Nov, 2019
Rajnagar	Cocos nucifera	17*	NS	10	5	5	15	4	5	NS	3	4	6	6	9	4	4	3	2	3
	Phoenix sylvestris	25	NS	15	4	4	22	9	13	NS	10	2	5	4	7	6	8	9	5	3
	Manilkara zapota	1	NS	0	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Albizia saman	2	NS	0	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Excoecaria agallocha	55*	NS	0	1	1	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Mangifera indica	3	NS	1	0	0	2	0	0	NS	-	-	1	-	-	1	-	-	-	-
	Psidium guajava	2	NS	2	0	0	2	0	0	NS	-	-	-	-	-	-	-	-	-	-
Borni	Cocos nucifera	10	7	3	0	0	3	1	2	NS	1	2	3	1	2	-	1	1	1	2
	Phoenix sylvestris	12	0	5	4	4	3	1	4	NS	4	3	4	2	1	-	-	1	1	-
	Borassus flabellifer	6	3	1	0	0	0	0	0	NS	-	-	-	-	-	1	1	-	-	-
	Mangifera indica	6	3	3	1	1	4	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Excoecaria agallocha	18	0	0	0	0	0	0	0	NS	-	-	-	-	-	-	1	-	-	-
	Swietenia mehogani	11	0	0	0	0	1	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Areca catechu	10	0	6	2	2	8	2	2	NS	-	1	-	3	-	-	-	-	-	-
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Psidium guajava	2	2	1	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
Kalekarber Dighi	Cocos nucifera	56	35	5	1	1	2	2	3	NS	1	1	-	6	3	-	1	3	1	7
	Phoenix sylvestris	10	0	3	0	0	1	0	1	NS	3	-	3	-	-	-	-	-	-	-
	Mangifera indica	5	1	1	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Manilkara zapota	2	0	0	0	0	1	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Borassus flabellifer	8	0	0	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Zizyphus sp	1	0	0	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Psidium guajava	8	0	0	0	0	0	0	0	NS	-	-	1	-	-	-	-	-	-	-
	Tamarindus indica	2	0	0	0	0	1	0	0	NS	-	-	-	-	-	-	-	-	-	-
Chalkghona	Cocos nucifera	39	25	19	5	5	34	20	0	NS	2	2	4	5	3	-	3	4	2	4
	Phoenix sylvestris	24	0	10	1	1	6	5	1	NS	1	-	5	2	3	-	-	1	2	2
	Albizia saman	3	0	0	0	0	1	0	0	NS	-	-	-	-	-	-	1	-	-	-
	Excoecaria agallocha	36	0	0	1	1	0	0	0	NS	-	-	-	-	2	-	-	-	-	-
	Manilkara zapota	1	0	0	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-
	Psidium guajava	17	1	7	0	0	0	0	0	NS	-	-	-	-	-	1	3	-	-	1
	Mangifera indica	7	2	1	0	0	0	0	0	NS	-	1	-	1	-	-	-	-	-	-
	Borassus flabellifer	2	0	0	0	0	0	0	0	NS	-	-	-	-	-	-	-	-	-	-

Note: NS = Not Surveyed

\*=1 Cocos and 45 Excoecaria have been cut

### Vegetation canopy status

#### Species representation in different canopy layers of homestead vegetation

Coconut (*Cocos nucifera*) occupied top canopy of all the studied homestead vegetation. Date Palm (*Phoenix sylvestris*) is prevalent as second top layer followed by Gewa (*Excoecaria agallocha*). Most of the fruit yielding trees like Sofeda (*Manilkara zapota*), Mango (*Mangifera indica*) possess upper bole of canopy layer. Lower bole are occupied by small fruit yielding trees like Guava (*Psidium guajava*), Musa sp. Very few grass species and undergrowth vegetation were followed at studied homesteads.

#### Estimated Canopy cover in homestead vegetation of sampling sites

Status of vegetation Canopy cover has estimated slightly less all the sites comparing to previous monitoring in July 2019. Recently, Cyclone Bulbul hit the area, fall some trees and also fall leaves all the trees. In addition, at, Kalekarber and Rajnagar, the home owners have

cleared some trees to make room there and land developed by sand. These two causes resulted the canopy coverage reduction. Canopy coverage of the studied homesteads has been represented in following **Table 3.15**

**Table 3.15: Vegetation Canopy Cover in different studied homesteads**

Location	% of Canopy Coverage																		
	Apr 2014	Jun 2014	Oct 2014	Jan 2015	Apr 2015	Aug 2015	Oct 2015	Jan 2016	Jul 2016	Oct 2016	Jan 2017	Jan 2018	Apr 2018	Jul 2018	Nov, 2018	Feb, 2019	Apr, 2019	Jul, 2019	Nov, 2019
Rajnagar	NS	19	19	17	20	20	20	20	21	23	19	15	18	14	11	22	19	18	16
Borni	NS	26	18	18	12	14	20	20	25	25	23	21	21	23	20	21	21	20	18
Kalekarber	NS	20	24	25	23	24	24	22	24	26	25	23	24	24	25	24	25	25	24
Chalkghona	NS	13	24	22	17	21	21	20	21	27	26	25	16	18	21	22	22	22	20

Note: NS = Not Surveyed

### Bird Habitat

#### *Local birds and their nesting behaviour*

Numerous local bird species are occurred in the study area. Homestead vegetation are the prime habitat for local birds. Existence of vast shrimp farms as well as canals and rivers also favor good number of water dependent bird species in this area. Most of the birds are nesting on tall trees of homesteads. Small bird like Tailor bird, prefer small bushy shrubs. Although, birds do not follow any local boundaries, a clear conception on available bird species have been gathered through discussions with studied homestead owners as well as physical observation.

#### *Migratory birds and their habitats*

Migratory and local migratory winter birds are followed at large shrimp gher along the study area. According to local people and physical observation, Common Coot, Common Snipe, Black Winged Stilt, Ruddy Shellduck, Little Grebe etc are common winter visitor of this area. In addition, local Ruddy Breasted Crake, Common Sandpiper, Great Egret, Pond Heron, Little Cormorant are also found at most of the monitoring wetlands of the study area.

Local Migratory birds have been observed at Borocharar Gher, Chotocharar Gher and Putimarir Gher which have been informed during recent field visit. Winter Migratory birds have informed only at Chalkghonar Beel. But the population is very low than previous years. According to local knowledgeable persons, population of migratory birds are reducing day by day from these wetlands for illegal hunting, re-starting shrimp culture within short intervals from shrimp harvesting in past year and indiscriminate use of pesticides in agriculture field and shrimp farms. In addition to this, construction vehicle movement through the approach road and vehicle lightings are disturbing the migratory birds which are roaming at the nearby wetland (shrimp farms). Following **table 3.16** show the presence of migratory birds at the important wetlands inside the study area.

**Table 3.16: Presence of migratory birds at different wetland inside the study area**

Wetland Name	Wetland type	Approximate distance from project Boundary (Km.)	Presence of Birds	
			November 2019	
			LM	M
Choto Charargher	Saline Water Shrimp Farm	0.10	Yes	No
Boro Charargher	"	0.10	Yes	No
Putimari Gher	"	1.10	Yes	No
Golbunia Gher	"	0.1	No	No
Shukariar Gher	"	1.25	No	No
Koigar Daskati Gher	"	0.25	Yes	No
Badyamari Gher	"	1.00	No	No
Chalkghonar Beel	"	1.50	Yes	Yes

Note: 'LM'=Local Migratory, 'M'=Migratory, 'Y'=Yes

### 3.2.4 Aquatic Ecosystem Monitoring

Rivers, canals, ponds and saline water shrimp farms are main wetland forms in the study area. Of which, river bear the flowing/ lotic and ponds bear the stagnant/lentic water systems. Canals of this area have merged with shrimp farms. Shrimp farms extend a large proportion of total watershed of the study area those are intervene by human. Therefore, canals are not an actual flowing or stagnant water system.

#### Monitoring Locations

Passur is the only external river beside the project area which maintains connectivity with all flowing water systems of the study area. On the other hand, Maidara River including two branches (Sailtakhal and Ichamoti) exists as an internal river system. Both of the river systems are support River Dolphin whole of the year. Hence, status of aquatic mammals (Dolphin) in these river systems has been monitored.

#### Dolphin Occurrence

##### Dolphin migration route in study area

Two dolphin species (Ganges River Dolphin and Irrawaddi Dolphin) travel throughout the Passur River for whole of the year. The Ganges river dolphin migrates from estuary regions to upstream connected rivers like Rupsha and Madhumoti. Though Irrawardi Dolphin is mostly habituated in estuary regions of Bangladesh, but this aquatic mammal is also occasionally sighted in Passur River. Ganges Dolphins also roam through Maidara River mainly during high tide. Siltation and narrowing of upstream branches is limiting the length of migration area of this river day by day.

##### Dolphin occurrence in Passur and Maidara River

Occurrence of dolphins have been monitored within about 12 km length of Passur and 1 km length of Maidara river surround the project area (From Digra Kheya Ghat to Chalna Bazar including Maidara River) through boat transact during low and mid spring tide. A total of 5 dolphins were recorded in Passur River during the survey.

Maidara River always supports as roaming ground of Ganges River Dolphin for easy prey of

fishes from this tiny tributary. A total of 4 dolphins were sighted along the 1 km river length. **Figure 3.11** represents the survey transect and location of dolphin occurrence. Most of the dolphins were abounded at the confluence point of Passur-Maidara River with an Encounter Rate of 0.4 individuals/km/hour (**Figure 3.12**).

#### Dolphin occurrence in Dhangmari Khal and Shella Gang

Dolphin occurrence also observed at the Dhangmari Khal, Chandpai Shella Gang Wildlife Sanctuary and Bhadra Khal. In the case of Dhangmari Khal, total transect length was 13.3 km from Dhangmari-Passur confluence to Gagramari Forest Patrol Post up and down (**Figure 3.13**). A total of 14 dolphins were recorded in Dhangmari Khal within about 2 hours and 20 min of transact time. The encounter rate was 1.05 individuals/km/hour.

In the case of Chandpai Shella Gang, the survey transect was bounded from Joymonirghol to Jongra Forest Patrol Post which transect length was about 11 km (**Figure 3.14**). A total of 13 individuals have been sighted during 77 minutes survey. The encounter rate was 0.93 individuals/km/hour.

Another survey were conducted at Bhadra Khal inside Sundarbans Reserve Forest during mid tide. During this monitoring, a total of 9 dolphins were recorded within the 3.5 km reach from Bhadra Patrol Post.

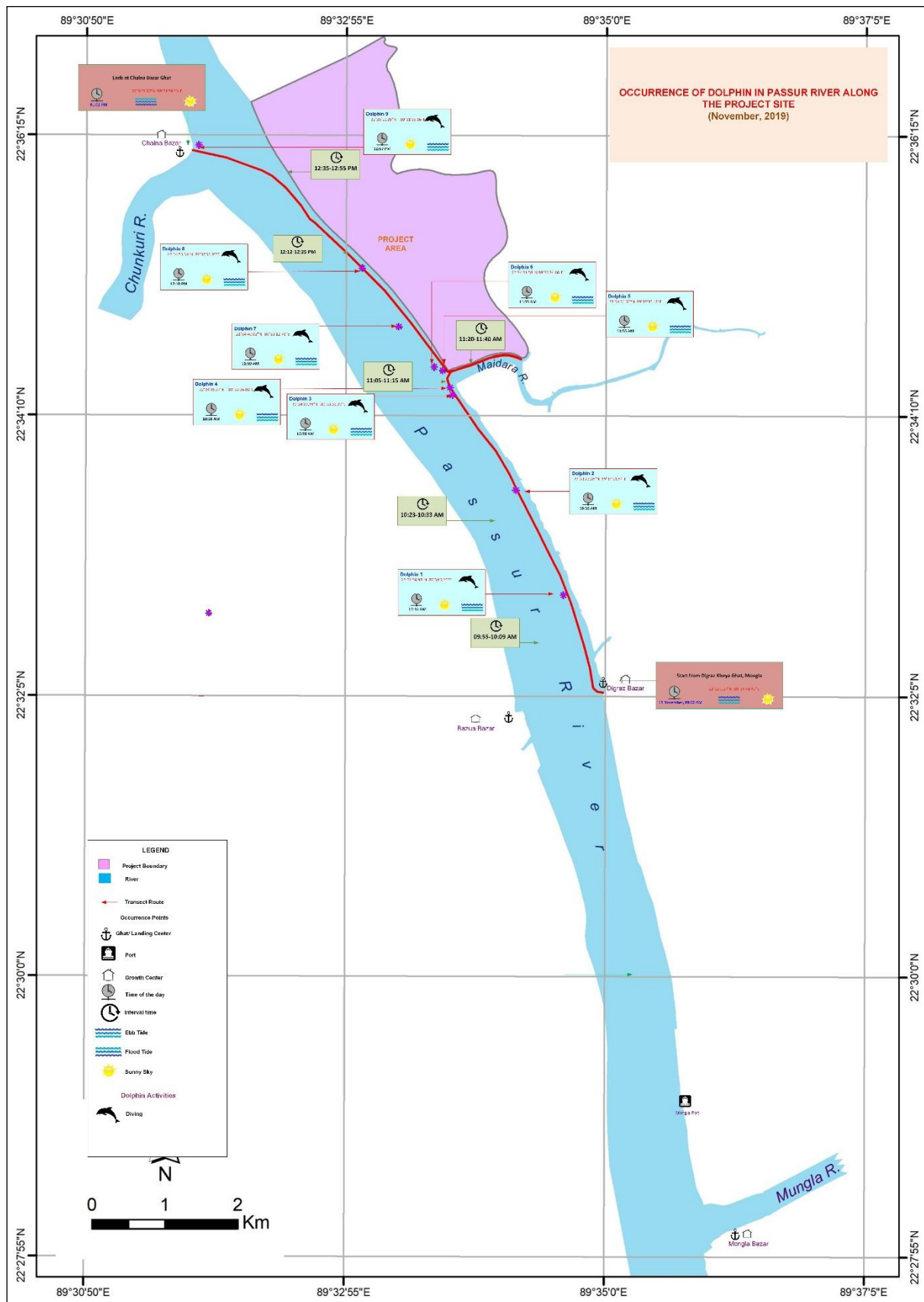
The distribution of dolphin occurrence at Bhadra Khal is presented in **Figure 3.15**.

Another short survey was conducted Karomjal, Harbaria and Akram Point while passing the river. Dolphin has been notified at Karomjal, Harbaria and Akram Point while travelling on boat. However, the survey result is included in **Table 3.17**.



**Figure 3.11: Surfing of Ganges River Dolphins at Dhangmari Khal (Left) and Passur-Maidara Confluence (Right)**





**Figure 3.12: Occurrence of dolphins at Passur and Maidara River along the project site**

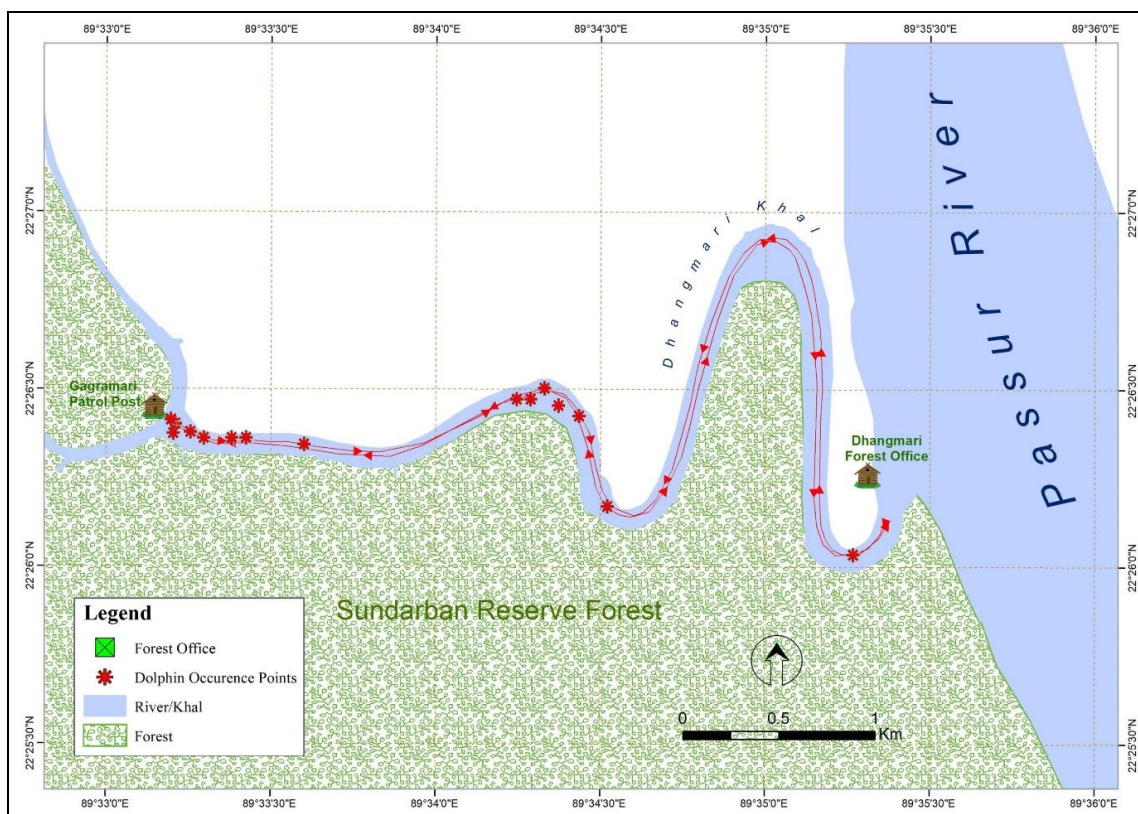


Figure 3.13: Location of dolphin Occurrence at Dhangmari Khal

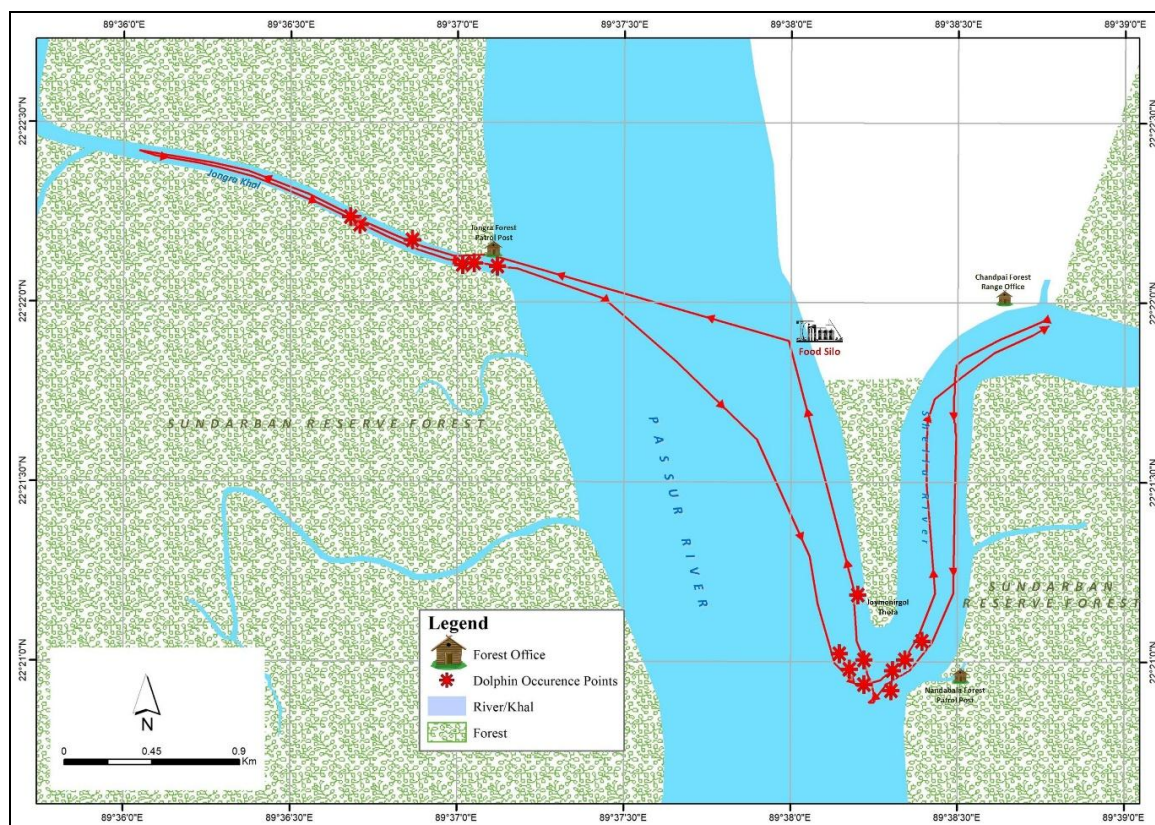


Figure 3.14: Location of dolphin Occurrence at Chandpai (Shella River to Jongra Khal)



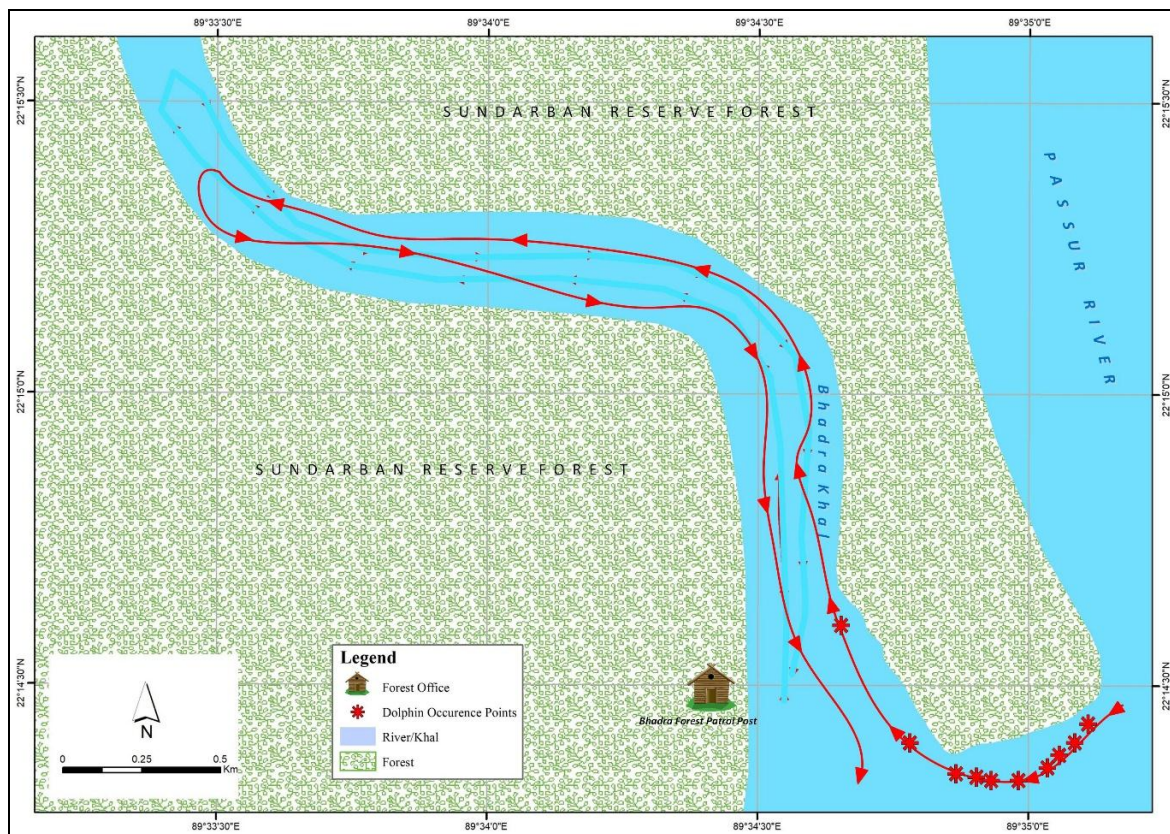


Figure 3.15: Location of Dolphin Occurrence at Bhadra Khal

Table 3.17: Dolphin observation Datasheet

Location of River systems	Occurrence Status																																			
	Apr 2014		Jun 2014		Oct 2014		Jan 2015		Apr 2015		Aug 2015		Oct 2015		Oct 2015		Jul 2016		Oct 2016		Jan 2017		Jan 2018		Jun 2018		Nov 2018		Feb 2019		Apr 2019		Jul 2019		Nov, 2019	
	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T
Project Site	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NS	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	NS	Y	NS	Y	NS	N	Y	Y	NS	Y
Karamjal	NS	NS	NS	N	NS	Y	Y	Y	N	N	NS	Y	NS	Y	Y	N	Y	NS	Y	Y	Y	Y	NS	Y	N	NS	N	N	Y	N	Y	N	Y	NS	Y	Y
Harbaria	NS	NS	NS	N	NS	Y	Y	N	N	N	N	N	Y	NS	Y	N	Y	Y	Y	NS	N	N	Y	N	N	N	N	N	Y	N	N	Y	N	N	Y	N
Akram Point	NS	NS	NS	N	NS	N	NS	Y	Y	Y	NS	NS	N	Y	Y	NS	NS	NS	N	N	NS	NS	N	N	Y	N	N	N	Y	N	N	N	N	N	N	Y
Moidara River	Y	N	N	N	Y	Y	Y	N	Y	N	Y	N	NS	Y	N	Y	Y	NS	NS	Y	N	Y	NS	Y	Y	Y	NS	Y	NS	N	NS	N	Y	N	NS	Y
Shella River at Chandpai	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N*	Y	NS	NS	Y	Y	NS	NS	Y	Y	NS	Y	Y	Y

Note: FT=Flood Tide, NT=Neap Tide, NS=Not Surveyed,

Occurrence Status: Y = Occurred, N = Not occurred

### 3.3 Sundarbans Forest Health

Forest Health Monitoring program designed to determine the status, changes, and trends in indicators of forest condition on certain time interval basis. The Forest Health Monitoring program uses data from various sources such as ground plots (i.e. long-term monitoring plot) surveys, aerial surveys, and other biotic and abiotic data sources and develops analytical approaches to address forest health issues that affect the sustainability of forest ecosystems. One of the widely used forests healthy monitoring Bio-indicators is growth trend overtime and its relation with leaf area index (Beets and Whitehead 1996). Stands with a high leaf area index will accumulate more biomass and total volume per ha than stands with a low leaf area, other things being equal (Beets et al. 2008). Lichen abundance is another good indicator of forest health. Lichens often grow on trees and shrubs, absorbing nutrients from the atmosphere. Because lichens are very sensitive to air pollution—particularly to sulfur dioxide, fluoride, and ammonia their presence or absence is an indicator of forest health. The acidity of a tree's bark can also affect lichen abundance (Smith et al. 2003). If air is very badly polluted with sulphur dioxide there may be no lichens present, just green algae may be found. If the air is clean, shrubby, hairy and leafy lichens become abundant (Bates et al 1996). The quality of the soil in a forest is another important indicator of forest health (USDA Forest Service. 2007). An evaluation of soil quality usually involves measuring the soil's physical, chemical, and biological makeup at different depths. Plant species diversity is another Bio-indicator of healthy forest. One way to assess this diversity is to determine whether there is a mix of plant species of different sizes and ages, thus creating forest "layers" that provide habitat for many species (Greenleaf Forestry and Wood Products Inc. 2010). A healthy forest has good regeneration capacity, which is also a bio-indicator of forest health monitoring. These bio-indicators will be investigated in Sundarbans Reserve Forest (SRF) in light of the Rampal Power Plant Installation.

Forest health Bio-indicators will be applied in Sundarbans Reserve Forest (SRF) to monitor the probable impacts of Rampal Thermal Coal Power Plant Project. To discern the true scenario of power plant impact on forest health, it is mandatory to create a baseline condition. Taking this into consideration, CEGIS is conducting forest health monitoring program at five locations namely Sutarkhali, Karamjal, Harbaria, Akram point and Hiron Point at Sundarbans Reserve Forest (SRF) along the Passur River. The parameters that included in this monitoring program were tree growth, regeneration capacity, lichen abundance, plant diversity, biomass and carbon stock.

### 3.4 Methodology

#### 3.4.1 Permanent Sample Plot (PSP) establishment and layout

To set up permanent sample plots, five plots were established (**Figure 3.16**). Among those, five sites are along the Passur River at Karamjal, Harbaria, Akram point and in Hiron point respectively and the fifth plot is near Sutarkhali forest office (**Table 3.17**). The sites were selected considering the distance from the proposed project site, wind directions, coal transportation route, river systems and vegetation types. In this present census, *Hiron* point was not considered.

#### 3.4.2 Bio-Indicators for Forest Health Monitoring

There are many Bio-indicators for forest health monitoring. As the study forest is a mangrove



forest, some of the mangrove traits were also selected as Bio-indicator. The Bio-indicators observed in this forest health monitoring program were seedling regeneration, pneumatophores, species diversity, crab hole density, canopy cover, leaf phenology, Leaf Area Index, Tree growth, phenological behaviour, pest and disease.

### 3.4.3 Sampling Design of Permanent Sample Plots (PSPs)

In each site, a transect line was laid out perpendicular to river or canal bank. Along the transect line, three circular nested subplots of 12.62m radius have been laid out at 100m intervals in order to capture the maximum tree species (**Figure 3.17**). Because of the variation in species composition in SRF, observation plots were laid out from the coast, river or canal side to upper slope zone where forest area is denser. The location of the first subplot was 40m away from ecotone zone in order to save the subplot from river bank erosion. The plot layout is shown in **Figure 3.18**.

**Table 3.18: General Description of Permanent Sampling Plots (PSPs)**

Transect	Plot	Range	Compartment No.	GPS $\pm$ (m)		Soil Description	Plot Location Notes
				Latitude (N)	Longitude (E)		
Sutar khali	1	Khulna	32	22.4981	89.4875	Hard Clay	Just opposite from Sutar Khali Forest Station and 40m SW from Sutar Khali Canal
	2	Khulna	32	22.4973	89.4871	Hard Clay	Just opposite from Sutar Khali Forest Station and 140m SW from Sutar Khali Canal
	3	Khulna	32	22.4965	89.4866	Hard Clay	Just opposite from Sutar Khali Forest Station and 240m SW from Sutar Khali Canal
Karamjal	1	Chandpai	31	22.4253	89.5943	Hard Clay	Plot centre 40m west from Passur River
	2	Chandpai	31	22.4252	89.5934	Hard Clay	Plot centre 140m west from Passur River
	3	Chandpai	31	22.4226	89.5925	Hard Clay	Plot centre 240m west from Passur River
Harbaria	1	Chandpai	29	22.2061	89.5924	Hard Clay	40m west from Passur River
	2	Chandpai	29	22.2962	89.5917	Hard Clay	140m west from Passur River
	3	Chandpai	29	22.2962	89.5908	Muddy	240m west from Passur River
Akram Point	1	Khulna	17	22.0195	89.5129	Hard Clay	40m east from Shibsha River
	2	Khulna	17	22.0187	89.5134	Clay	140m east from Shibsha River
	3	Khulna	17	22.0180	89.5140	Hard Clay	240m east from Shibsha River
Hiron Point	1	Khulna	44	22.7753	89.4610	Sandy	350m east from Gogari Canal
	2	Khulna	44	21.9166	89.2333	Sandy	40m north from Bay of Bengal
	3	Khulna	44	22.1833	89.5000	Hard Clay	648m south east from Shibsha River





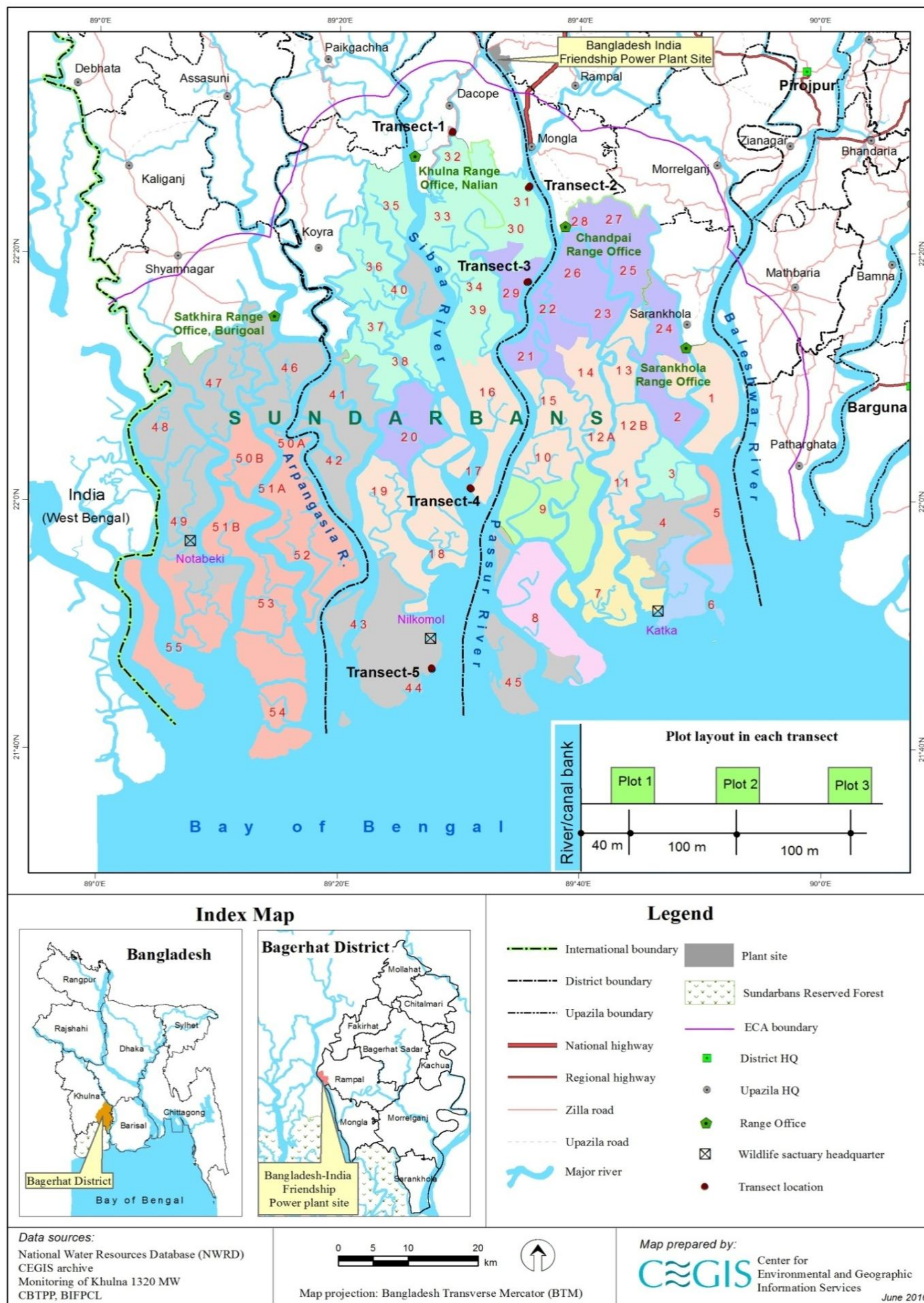
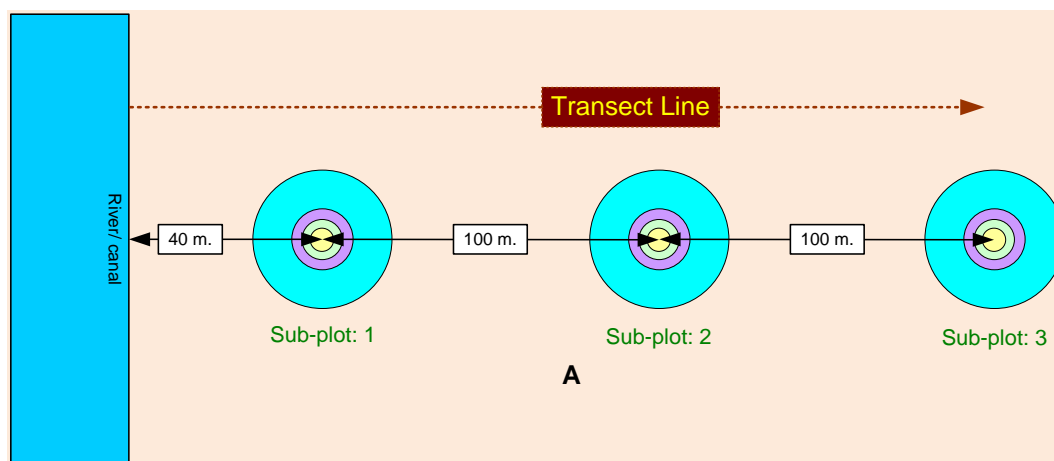


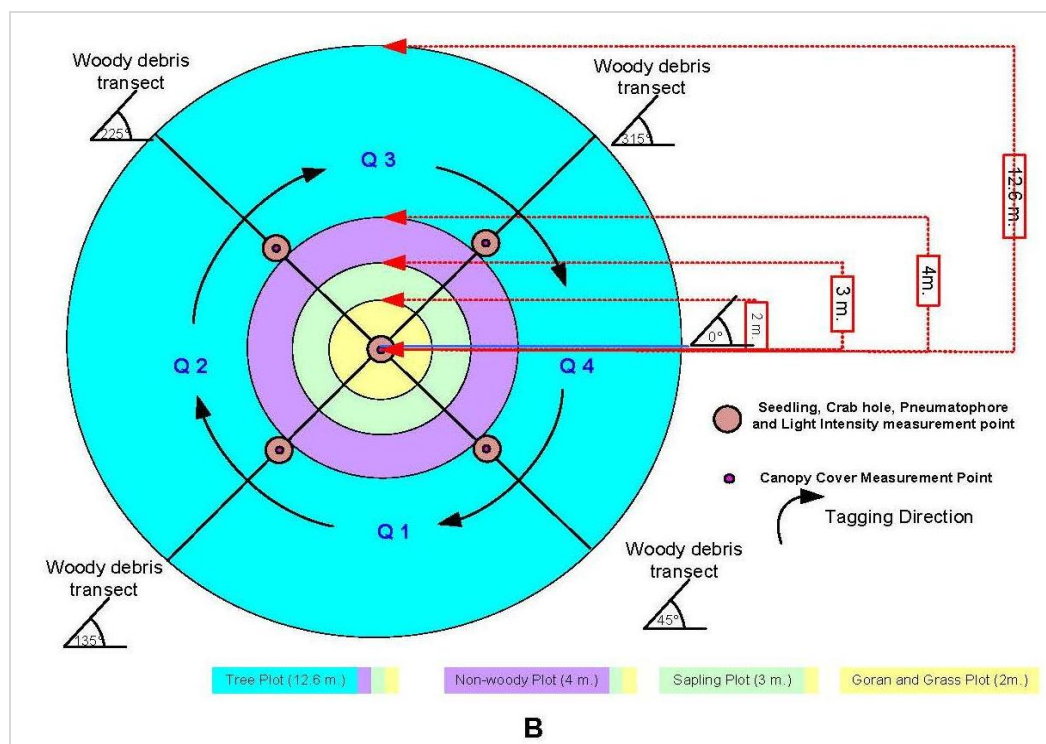
Figure 3.16: Location Map of Sundarbans Forest Health Monitoring Plots (PSP)







**Figure 3.17: Layout of the subplots and transect line perpendicular from ecotone (river or canal bank)**



**Figure 3.18: Layout of the survey activities in each subplot**

### 3.4.4 Methods

#### *Tree growth*

Tree species growth data were obtained from measured tree DBH. Individual tree DBH  $\geq 5\text{cm}$  was considered for growth trend observation.

#### *Vegetation Diversity*

Tree species data were collected from the PSPs. Individual tree DBH  $\geq 5\text{cm}$  was considered. Saplings (DBH  $< 5\text{cm}$  and height  $1.37\text{m}$ ) and seedlings (height  $< 1.37\text{m}$ ) were assessed within 3m and 2m radius circle respectively in each PSP. Seedlings were counted species wise



and their status of living was also recorded. For saplings, species name and DBH were recorded along with the living status.

Diversity analysis was calculated using the species richness, Shannon diversity ( $H'$ ), and Simpson diversity ( $D'$ ) and Evenness ( $E$ ) indices (Magurran & McGill 2011). All the calculations were done using R package (Kindt & Coe 2005). Species accumulation curves (SAC; or species-richness curves, collector's curves, species effort curves) were used to estimate the number of vegetation species in the PSPs. Species accumulation curves shows the species richness for combinations of sites. Canonical Correspondence Analysis (CCA) was used to analyze the relationship between distribution of plants and environmental variables. Multidimensional scaling (MDS) was applied to investigate similarities in species composition among sites.

#### *Pneumatophores*

The total numbers of living pneumatophores were recorded within a circular area of 1m radius centering each of the four points of all the subplots.

#### *Crab hole*

Crab plays an important role in mangrove ecosystems such as decomposing litter fall which play an important role in increasing soil fertility. In order to record the crab density, crab hole abundance was monitored. For this purpose, the crab holes were counted within an area of 1m radius circle in each subplot's centre and in the midpoint of four transect.

#### *Canopy Cover*

Canopy cover percentage was estimated by a spherical densitometer (i.e. Densitometers a gridded convex mirror that provides a simple and inexpensive approach of measuring canopy cover). The densitometer was held at a distance of 30–40 cm from the body and at an elbow height so that head not become visible in the mirror. After levelling the instrument using the level bubble, the dots which had not been occupied by canopy were systematically counted. In each subplot, the meter readings have been taken at four points facing north, south, east, and west direction including the centre point of the subplot. The canopy cover was calculated by taking the average of these readings.

#### *Leaf Area Index*

Leaf Area Index (LAI) is a key structural characteristic of forest ecosystems because of the role of green leaves in controlling many biological and physical processes in plant canopies. LAI influences net canopy photosynthesis. Light absorption by the forest canopy can be used to estimate Leaf Area Index (LAI). In this monitoring report, LAI was calculated as follows:

Leaf Area Index (LAI) =  $\log_e (I/I_0) / -K$  leaf area / area of ground (Where,  $I$  = Under Canopy Light Intensity,  $I_0$  = Open Canopy Light Intensity and  $K$  is Canopy light extension coefficient i.e., 0.5)

#### *Biomass and carbon stock estimation in trees*

From each plot tree species were identified and each individual was recorded. Diameter at breast height (1.37m) and height was measured in the field. Total biomass of trees was estimated after adding above and below ground biomass. As the study was conducted in a

reserved forest area, it was not possible to cut all the trees and brought them to laboratory for estimating biomass. After reviewing models developed by several authors from across the world (e.g., FAO 1997, Brown et al. 1989), the generic allometric model developed by Chave et al. (2014) was used for measuring biomass as this widely used for tropical region tree standing biomass. Below ground biomass was calculated considering 15% of above ground biomass (Mac-Dicken 1997). After calculating biomass, carbon content was calculated based on the assumption that carbon content is 50 percent of the dry woody biomass (Brown 1997). Aboveground biomass and carbon were calculated on a per-hectare (ha) basis. The model for above ground biomass estimation is as follows:

$$AGB = 0.0673 \times (\rho D^2 H)^{0.976}$$

Where, Y = above ground biomass in Kg; H = Height of the trees in meter; D = Diameter at breast height (1.3m) in cm;  $\rho$  = Wood density in units of g/cm<sup>3</sup>.

#### *Leaf Phenology*

Leaf phenological trait of major mangrove species such as leaf emergence, leaf shedding, flowering and fruiting and fruit/ propagule dropping time was investigated through secondary information. Leaf phenology has been first introduced in this study for the first time. From next field inventory, leaf phenological behavioral change will be monitored.

#### *Pest and Diseases*

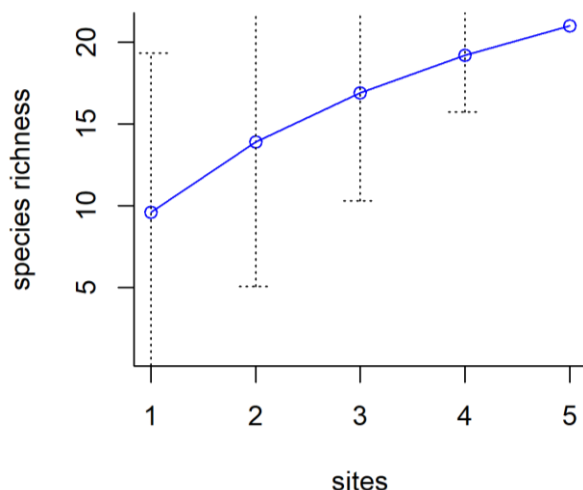
Pest and disease type of the Sundarbans mangrove forest was investigated through literature review, which was then verified in the field through visual observation.

### **3.5 Results and Discussion**

#### **3.5.1 Vegetation diversity, richness and compositional variation**

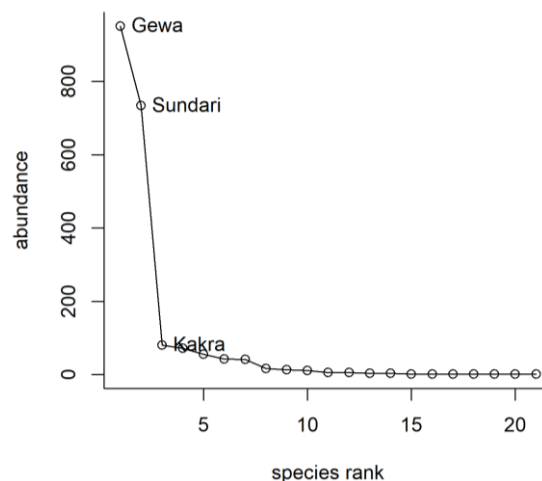
A species accumulation curve shows the species richness for combinations of sites. These curves portray the average pooled species richness when all sites are combined together. The output shows that the average richness for all possible combinations of 5 sites is 21 (**Figure 3.19**). Gewa was the dominant species among all the PSPs which was confirmed by the Rank-abundance curves followed by Sundari and Kakra (**Figure 3.20**). Vegetation species richness has been identified through Shannon, Simpson and evenness Index (Table 2). Considerable difference was noticed in the species richness in five PSPs. All the three indices show that transect 2 (Karamjal) has more diversity compare to other PSPs.

Multidimensional scaling (MDS) is a popular approach for graphically representing relationships between objects (e.g. plots or samples) in multidimensional space. The samples are then usually represented graphically in two dimensions such that the distance between points on the plot approximates their multivariate dissimilarity as closely as possible. In the present study, Akram point (T4) and Hiron point (T5) were close to each other indicating similarity in species composition in these two PSPs. In contrast, T1 (Sutarkhali), T2 (Karamjal) and T3 (Harbaria) were far away from T4 and T5 indicating dissimilarity in species composition (**Figure 3.21**).



**Figure 3.19: Species accumulation curve for the PSPs dataset. The bars indicate +2 and -2 standard Deviations**

(N.B. 1=Sutarkhali, 2=Karamjal, 3= Harbaria, 4=Akram Point, 5=Hiron Point.

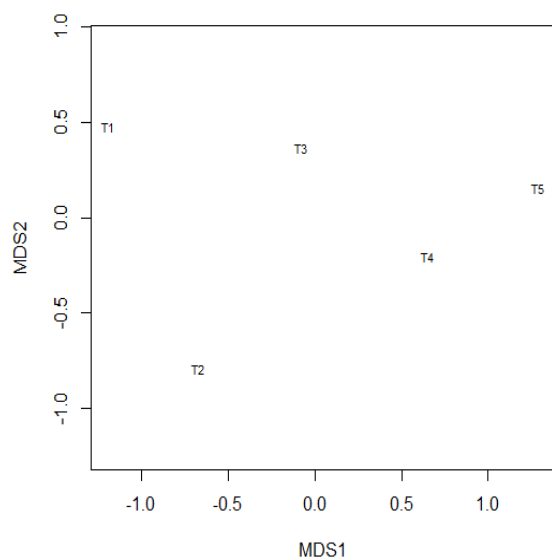


**Figure 3.20: Rank-abundance curve for the sampled PSPs**

**Table 3.19: Diversity indices for vegetation in the Sampled PSPs**

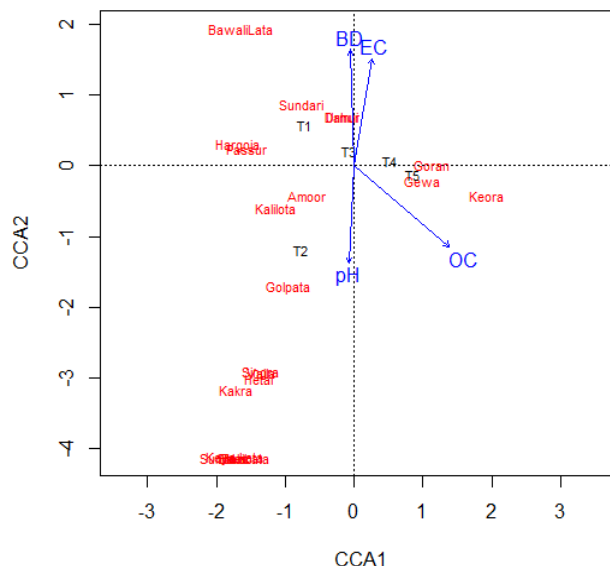
PSPs	Shannon Index	Simpson Index	Evenness Index
Sutarkhali (T1)	1.06	0.46	0.26
Karamjol (T2)	2.09	0.83	0.44
Harbaria (T3)	1.31	0.64	0.25
Akram Point (T4)	0.83	0.47	0.39
Hiron Point (T5)	0.47	0.22	0.23

Multidimensional scaling (MDS) is a popular approach for graphically representing relationships between objects (e.g. plots or samples) in multidimensional space. The samples are then usually represented graphically in two dimensions such that the distance between points on the plot approximates their multivariate dissimilarity as closely as possible. In the present study, Akram point (T4) and Hiron point (T5) were close to each other indicating similarity in species composition in these two PSPs. In contrast, T1 (Sutarkhali), T2 (Karamjal) and T3 (Harbaria) were far away from T4 and T5 indicating dissimilarity in species composition (**Figure 3.22**)



**Figure 3.21: Ordination graph for a two-dimensional MDS based on the Bray-Curtis distance**

The best configuration out of 500 is shown.



**Figure 3.22: CCA ordination. The vectors represent environmental variables**

The length of the vector is proportional to its importance and the angle between two vectors reflects the degree of correlation between variables. The angle between a vector and each axis is related to its correlation with the axis.

### ***Soil quality and vegetation distribution nexus***

The first axes (CCA1) of CCA explained 25.5% of the cumulative variance in species data. Observed values of the correlation co-efficient ( $r$ ) between the environmental variables and the axes scores suggest that a combination of factors is responsible for the variability in species composition. For instance, the first CCA axis (eigen value = 0.43, variance explained = 57%) primarily represented a gradient of high-to-low organic carbon ( $r = 0.42$ ) and low-to-high soil salinity ( $r = 0.07$ ), and the second CCA axis (eigen value = 0.29, variance explained = 37%) primarily represented a gradient of soil with low-to-high concentration of BD ( $r = 0.50$ ) and Salinity ( $r = 0.46$ ) in soil (**Figure 3.22**).

CCA biplot (Figure 3.22) indicates that Gewa, Goran and Keora in transect 4 (Akram Point) and transect 5 (Hiron Point) were strongly associated with high soil organic carbon/organic matter content while Bawalilata, Sundari, Hargoja, Passur, Dahur have opposite associations with OC/OM. Sundari, Hargoja, Passur, Dahur were associated with high soil salinity (EC) and BD while Kalilata, Golpata, Amoor were associated with high soil pH.

### **Status of forest health indicators**

There was no significant variation ( $p > 0.05$ ) in tree growth over the monitoring period for all the PSPs (**Figure 3.23**). The Seedling density among the four PSP was not significantly different ( $P > 0.05$ ) except Akram point (**Figure 3.23**). An increasing trend of seedling survival was found in all sites. This is because of the time of seed germination and seedling survival in the observed PSPs.

Trees of swamp habitats or those subject to tidal flooding, such as mangroves, often have specialized root systems, called pneumatophores, which often are involved in gas exchange. Average number of pneumatophores per hectare was comparatively very low in Akram point area whereas pneumatophores density was highest in karamjol sample plots. There is no significant variation ( $p>0.05$ ) in pneumatophores density over the monitoring period for each PSPs (**Figure 3.23**). This indicates that forest health condition is not deteriorating in terms of steady state condition of pneumatophores density over time.

There is no significant variation ( $p>0.05$ ) in crab density over the monitoring period for Harbaria, Sutarkhali and Karamjol PSPs (**Figure 3.23**). However, Akram point and Hiron point crab density was significantly different than the other three sample plot ( $p<0.05$ ).

All the PSPs (Sutarkhali, karamjol, herbaria point) canopy cover doesn't vary significantly ( $P>0.05$ ). Akram point PSP's permanent plot canopy cover was lower compare to the rest of PSPs canopy cover percentage (**Figure 3.23**).

The LAI (Light Area Index) influences daily rate of net canopy photosynthesis which results in exchange of atmospheric  $\text{CO}_2$ . The minimum the ratio of under canopy to open canopy light intensity value indicates the maximum LAI. There was no significant prominent trend observed for all the PSP's (**Figure 3.23**).

The phenological events such as leaf emergence, leaf shedding, flowering and fruiting and fruit/ propagule dropping time may have affected by Air pollution. Hence, Phenological behavior can be used as bio-indicator of forest health. This indicator was introduced for the first time at 19th Monitoring (January, 2019) for the Sundarban Reserve forest monitoring. Phenological behavior of major mangrove species was summarized in Table 3. There were no changes observed in phenological behavior of the dominant tree species during the monitoring period.

Diseases in trees can also be used as forest health bio-indicator. A number of diseases has been identified by researchers as chief causes of population decline of the tree species *Avicennia* spp., *Rhizophora* spp., *Heritiera* spp., *Pandanus* spp., *Phoenix* spp. and *Acanthus* spp (Rahman et al. 2010). Certain important diseases of Sundarban mangroves are leaf blight, Dieback, stump and collar rot, trunk gall, root rot, leaf blight, leaf necrosis, powdery mildew (Rahman et al. 2010). However, in the present study, 'top dying' of Sundari was observed in all the PSPs. Almost most of the Sundari trees were suffering from 'top dying' disease.



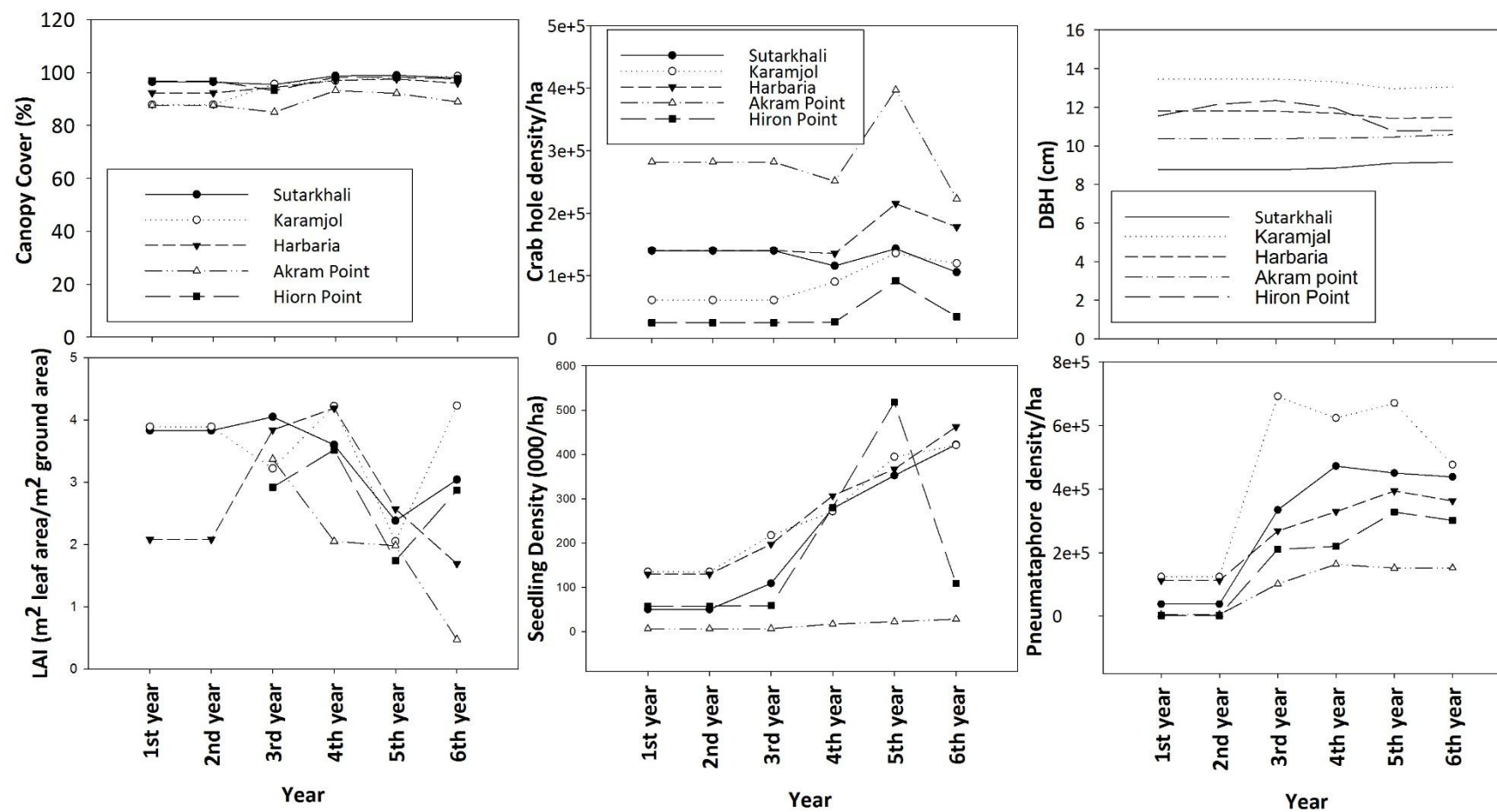


Figure 3.23: Seedling Density, Pneumatophore, Crab Hole Density, LAI and Diameter Increment (DBH) over different census period

(N.B. Each year represent average of 4 monitoring period except for 6<sup>th</sup> year)

Table 3.20: Phenological Behavior of Major Mangrove Species in the PSPs

Species	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Leafing</b>												
Sundari												
Gewa												
Goran												
Kakra												
Passur												
<b>Leaf Shedding</b>												
Sundari												
Gewa												
Goran												
Kakra												
Passur												
<b>Flowering</b>												
Sundari												
Gewa												
Goran												
Kakra												
Passur												
<b>Fruiting</b>												
Sundari												
Gewa												
Goran												
Kakra												
Passur												
<b>Seed/Popagule dropping time</b>												
Sundari												
Gewa												
Goran												
Kakra												
Passur												

Source: Rahman and Islam. 2015.

### 3.5.2 Summary

In light of Rampal Power plant installation, the authority took initiative to monitor Sundarbans forest health periodically along the Passur River. Various bio-indicators such as tree growth, species diversity, seedling regeneration capacity, phenmetaphore occurrence, crab hole density, canopy cover changes, Leaf Area Index, leaf phenology, pest and diseases were observed in the permanent sample plots (PSPs) along the Passur River over time. Monitoring results shows that Gewa (*Excoecaria agallocha*) was the dominant species among all the PSPs followed by Sundari (*Heritiera fomes*) and Kakra (*Bruguiera gymnorhiza*). Species diversity indices shows that sample plots of Karamjol has more diversity compare to other PSPs. When similarity in species composition was considered, Akram point and Hiron point has similarity in species composition compare to Sutarkhali, Karamjol and Harbaria. There was no significant variation in tree growth, pneumatophores density, crab hole density, canopy cover changes, Leaf Area Index and canopy cover over the monitoring period for all the PSPs. Among site comparison shows that average tree

diameter is higher in Karamjol whereas lower at Hiron Point. However, there is no significant tree growth declining trend was observed. Pneumatophores density was comparatively very low in Akram point whereas highest in karamjol PSPs. Akram point canopy cover was lower compare to the rest of PSPs canopy cover percentage. However, no significant variation among sites were observed. Seedling and crab hole density among the studied plot was mostly similar and shows a slightly increasing trend. Seedling density was comparatively less in Akram point because of low seedling recruitment and survival rate. Among all the PSPs, Akram point has the highest crab holes whereas Hiron point has lowest number of crab holes. In case of Leaf Area Index (LAI), there was no significant variation observed among sites. No severe pest and disease attack were observed in the monitoring PSPs except top dying symptom of Sundari (*Heritiera fomes*). Phenological changes were not observed in all PSPs. Overall, it can be said that forest health along the Passur River is in stable condition (i.e. no detrimental condition) except top dying of Sundari (*Heritiera fomes*) tree species.



## **4. Social Environment**

### **4.1 Socio-economic Condition and Social Safeguard**

The Social Safeguard report was prepared based on the 22th quarterly field visit. Social safeguard indicators during the construction phase was monitored and analyzed according to field observation, informal interview and consultation with relevant stakeholders. Social safeguard indicators (i.e. working condition, employments and livelihoods, community health, and corporate social responsibility) were monitored in relation to the findings found during this stage of monitoring at the project site as well as affected areas under the project.

### **4.2 Methodology**

#### **4.2.1 Physical Observation**

The Physical observation was carried out to understand the construction activities, status of occupational health and safety, condition of labor shed, toilet facilities for workers, kitchen, drinking water and food condition of labor sheds, use of PPE by the construction workers and waste management status. Based on this status, compliance status also identified and suggested further measures for upgrading the desired compliance status according to the conditions of DoE.

#### **4.2.2 Consultation**

A consultation meeting was held at the project site getting brief of compliance status as a follow up of the status of conditions set by the DoE. During this meeting, general conservation held to identify the CSR initiatives and their present status, use of PPE and overall working condition. Additionally, future plan on CSR activities had been identified and suggested for making a sustainable management of construction activities and making a balance between people and the Rampal Power Plant.

#### **4.2.3 Informal Interview**

Informal interviews were carried out with affected people living in the Foyla and Kapasdanga, and construction workers living in the labor sheds. Present conditions of CSR activities performed by the power plant authority, and their concerns and suggestions for further improvement had been identified through those informal interviews during the visit.







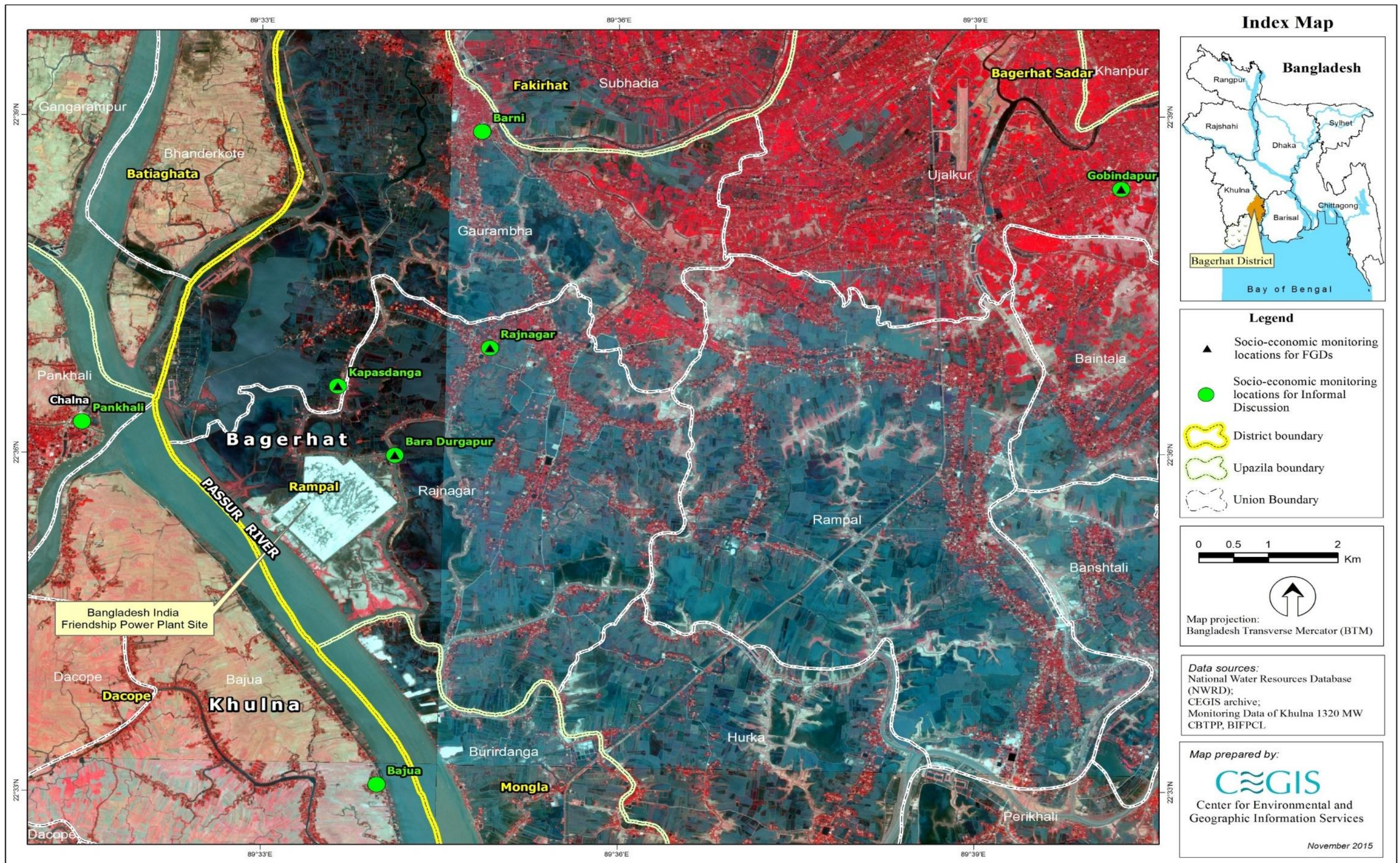


Figure 4.1: Socio-Economic Environment Monitoring Location





### *Project Related Employment Generation*

In this stage of monitoring, it is depicted that about 20% of semi-skilled labors hired from nearby communities and it helps them to get income opportunities. The BIFPCL has been working to engage more local labor force but lack of proper skills, people's tendency not to work as construction workers made the situation difficult to get them involved properly.

In this aspect, BIFPCL has made a plan to engage local people making them skilled/semi-skilled in which they can become assets for being the part of this power plant in the near future. However, Bangladesh Industrial and Technical Assistance Center (BTAC) has been selected by the BIFPCL and a MoU will have to be signed for making initiatives in reality. Initially, PMU has fixed selection criteria and consulted with respective local representatives for getting people from the local communities to involve them in different training batches.

With the identification of the need for direct recruitment of directly affected people, the PMU of BIFPCL has made a plan in which interested affected people can get a chance as a working force during the construction phase of the project. Presently, more than 4,500 people are working whereas Bangladeshi and Indian people are working, which allowed employment and livelihoods opportunity for those who can be interested to join as workforce during the phase of construction.

### *Labour and working condition*

For avoiding accidental cases and a safe working environment, the PMU has set a plan “No training No work” moto, as a result, no worker cannot get the entrance without a proven test result on different safety issues. The training center established at the power plant premise made a way for people to make them fit for working on height, use of protective equipment and ensuring overall working safety for construction workers at the construction site (**Figure 4.2**). After getting the pass mark with the proven test, construction workers get entrance to the project site and start working. Every day, toolbox training conducted by the safety manager which was monitored by the PMU, and observation of BHEL written in a document to address noncompliance issues, if they have. For ensuring proper waste management at the labor shed, new dust beans are supplied to every labor camps and kitchen and other waste are being managed accordingly.



**Figure 4.2: Safety Training in Working at Height**

There are different labor sheds under each contractor (those are working under the EPC contractor). Labor sheds equipped with several toilet facilities, kitchen, waste management

system, drainage, and drinking water and supplied water facilities. The BIFPCL and BHEL used to visit the labor sheds to monitor worker's condition and utility facilities provided in the labor sheds. With the observation found during each visit, the engaged safety engineer issued a file in which subcontractors can take necessary action to fulfill the compliance.

### *Community Health*

The Project authority was very much concerned about the community health. Top soil blown away when construction work is ongoing. For protecting dust pollution, water sprayed 4 times in a day. There is an air pollution monitoring machine installed by DoE, the range of different parameters observed every day to monitor health issues (according to the test results) regarding the dust pollution.

Night shift work has been regulated as local people couldn't face noise problem. Use of heavy machineries were restricted to avoid accidental cases during the work at night shift. Speed limits addressed within the project boundary for avoiding the risks of accidents.

The PMU are concerned to establish a green environment in which they made contract with the DoF for making initiatives visible. In this regard, trees (more than 65,000) are planted within the project boundary, and rest of the plantations are under processing (**Figure 4.3**). According to BIFPCL, they are monitoring the survival status and made emphasis to make sure the greenery environment within the project area.



**Figure 4.3: Tree Plantation program inaugurated by the Project Director of Moitree Power Plant**

### **Medical Campaigns**

With the presence of a MBBS Physician, medical campaigns were held in both project site as well as at the affected Unions. Following **Table 4.1** shows the status of medical campaign held under the CSR of Rampal Power Plant. A total of 47,623 people were received free treatment from medical campaigns held under the CSR activities of Rampal Power Plant. Besides, a total of 3234 people received treatment from the campaigns held in different unions. A boat medical camp was inaugurated recently whereas 282 local people got free medication. In addition, free medical camp for labor was held in November 2019 whereas a 283 labors received free medical treatment (**Figure 4.4 to Figure 4.7**).



**Table 4.1: Status of medical campaigns under CSR activities**

SI no	Type of Medical Camps	Locations	Quantity of Camps	Number of Patients
01.	Regular Medical Camp	MSTPP	436	43518
02.	Monthly Medical Camp	Rajnagar, Gaurambha, Hurka, Burirdanga	11	3234
03.	Labor Colony Medical Camp	Afcons Labor Colony	02	588
04.	Boat Medical Camp	Kapasdanga	01	283
<b>Grand Total</b>				<b>47623</b>

Source: BIFPCL, December 2019

**Figure 4.4: Medical Campaign held At Rampal Power Plant Site****Figure 4.5: Free medical camp at AFCONS labor colony****Figure 4.6: Mobile Boat for BIFPCL free medical camp****Figure 4.7: Inauguration of Free Boat Medical Camp**

## Community Development

Considering the high rate of salinity in the drinking water, a Reverse Osmosis (RO) plant for desalinizing of water was established under the CSR program of the Power Plant. The Desalinization plant with the capacity of 1000 liter (per hour) was completed in the Burirdanga union that would be used for people of this union. According to the local people, this plant would be very effective in getting pure drinking water which was very essential for people of this union. The BIFPCL received an award from Red Crescent Society for organizing blood donation camps. The recognition was made BIFPCL proud to enhance their community development programs (**Figure 4.8**).



**Figure 4.8: Inauguration of RO plant at Burirdanga Union**



**Figure 4.9: Award Receiving Ceremony of BIFPCL on Blood donation camps**

## Capacity Building Programs

According to the BIFPCL, Bangladesh Industrial Technical Assistance Centre (BITAC) was associated as the partner organization for providing technical assistance and services for improving the skill and capacity of the local communities.

A MoU was between BIFPCL and BITAC is on the process of signing and it would be very effective getting service on electronics, mechanical, welding, electrical and other trades and the capacity development program would be running under the CSR activities of Rampal



### Power Plant.

Students from the local communities would be identified in consultation with the LGI representatives and teachers and local people. With the identification of eligibility and needs interested people would be identified and the program would be continuing as a part of the CSR activities. The successful candidate would get the priority to be engaged in the power plant and related jobs within the locality, according to the PMU of Rampal Power Plant (**Figure 4.10 and 4.11**).

Besides, under the capacity building program, till now, about 186 persons received training on sewing, and about 190 persons got the ICT skill development training. Local people from Gaurambha, Rajnagar, and Burirdanga unions participated in this skill development training program.



**Figure 4.10: Computer Training under the CSR Activities**



**Figure 4.11: Sewing Training under the CSR Activities**

### Recommendations

- a. People of adjacent area from the power plant area want to know about the present activities for being aware about the environmental and social issues regarding the project aspects in the near future. Therefore, it is requested by the local communities to arrange some presentations, posters, banners and festoons and deliver some awareness programs in schools and colleges about the Rampal Power Plant;
- b. All machineries should be checked properly before using to avoid the risk of accidents;
- c. For assessing the needs of local communities and future CSR activities, it is required to sit together where LGI representatives, local people, civil society members, journalist can participate to identify and share their needs;
- d. For arranging vocational training on carpeting, electrician & electronics, welding, driving, safety, rock binding, and machineries, it is required to make a contract with a professional organization;
- e. For avoiding the mortality of trees and effective green environment (according to DoE conditions) it is required to recruit a forest plantation expert to monitor the planted trees properly;

- f. The conditions of labor sheds should be cleaned for creating a good environment;
- g. The number of toilets and beds for labors should be increased for making better living environment at the labor sheds;
- h. Night shift work should have to be organized properly to avoid the risks of accidental cases and sound pollution that would increase the sound related problems at the community level;
- i. Equitable distribution of CSR activities should be followed by engaging all affected people living different unions. A monitoring team should be involved for following up the activities held the CSR programs;
- j. Spraying of water should be continued on construction sites, and other places where necessary to suppress dust and the risks of air pollution;
- k. The PMU should be prompt to maintain the speed limits for the vehicles visited the power plant site;
- l. Direct recruitment would be required for the directly affected people who were resided at the inside of the power plant.

## 5. Environmental Compliance

### 5.1 Introduction

The project is now at the middle of construction works progress. Maitree Super Thermal Power Project (MSTPP) is progressing fast prioritizing the environmental management plan. The Engineering, Procurement and Construction (EPC) contractor has deployed a number of contractors and sub-contractors sequentially or simultaneously for completion of the project works within the stipulated time.

During the environmental compliance monitoring of Power Plant Construction program, it was observed that all of the construction package has been commenced for this stage. The civil construction activities at the Boiler, Turbine and Generator installation areas, cooling tower, Chimney and other heavy equipment installation areas, stack point, Jetty, township, internal road networks, permanent drainage networks, have been progressing fast. Even the mechanical construction works are continued to install the machineries like boiler, ESP, FGD, Turbine etc. Equipment are transported to the Project site by road. However, the permanent jetty construction works are advancing for unloading the heavy machineries transported through waterways by the Passur River.

The approach road including extension of the two-lane approach 5.5 km road from Babur Bari point at Khulna - Mongla Highway to the Project site has been completed. All of the light posts and power transmission line posts have been restored after falling during the cyclone Bulbul. The bridges and culvert area have already been extended to six lane road requirement. Permanent structure for the security staff and visitors have been constructed at the entrance point approach point and entrance point of the power plant project. Boundary wall around the Project area, slope protection, office building, roads and drainage system are also at the completion stage.

The main Project Office of BIFPCL and EPC contractor's office are shifted to the newly constructed buildings. Number of professionals of BIFPCL have been shifted to the newly constructed townships. At the same time, the EPC contractor i.e. Bharat Heavy Electricals Limited (BHEL) has already employed different local specialized sub-contractor construction firms such as DIPON, KELLER, AFCON, POWER MAC etc. for progressing the construction works simultaneously.

The present environmental compliance monitoring includes the status of EMP implementation based on physical observation, investigation and interviews by the study team. A comprehensive due diligence checklist has been developed to monitor the environmental compliance of different components e.g., Environmental and Social Management System and Action Plan; Labor and Working Condition; Community Health, Safety and Security; Biodiversity and Sustainable Management of Living Natural Resources.

The aim of this compliance checklists is to check the diligence and effectiveness of the measures. The checklists are produced as Compliance Data Sheet that contains both quantitative and qualitative data. The details of the compliance checklist are attached in Appendix I. The summary of findings of the environmental compliance monitoring are presented in the following **Table no. 5.1, 5.2, 5.3 and 5.4** respectively.



Table 5.1: Monitoring of Environmental and Social Management System Action Plan Implementation

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	a. Generation of Noise within the BIFPCL's Plant construction premises	<ul style="list-style-type: none"> <li>Switch off / throttle down all site machinery, vehicles, water vessels, and generator when not in use</li> <li>No construction activities at night</li> <li>Use noise damper within the project boundary, Limit vehicle speed and monitor it at every suitable point.</li> </ul>	<ul style="list-style-type: none"> <li>Noise level has been monitored periodically every month for both night and day time at different potentially sensitive areas and compared with the ECR Standard.</li> <li>Noise levels were found within the permissible limit near the project boundary but breach at the labour colony.</li> <li>Workers at heavy noise generating activities (i.e. piling, rod cutting) were found using PPE e.g. ear plug.</li> <li>Idle machines/equipment/ generators were found switched off/throttled down.</li> <li>Construction activities were found continuing at night time.</li> <li>Air tighten door, silencer of the vehicles, acoustic enclosure for the generator has been recorded</li> </ul>	<ul style="list-style-type: none"> <li>EMP measures other than avoiding construction activities at night were found complied.</li> <li>The Project authority should informed to the regulatory authority about the working hour for completion of the Project.</li> <li>All of the locations inside the power plant boundary should be considered as industrial area for compliance monitoring</li> </ul>	<ul style="list-style-type: none"> <li>If construction activity at night is unavoidable, additional measures to limit noise (within permissible standard) should be taken.</li> <li>EMP measures as proposed in the EIA regarding construction activities at night need to be followed.</li> <li>Use of enclosure to protect the noise sources</li> <li>Schedule to be made for heavy noise generating works.</li> <li>Alert nearby community beforehand about activities and possible noise generation.</li> </ul>
2	b. Dust generation from construction works	<ul style="list-style-type: none"> <li>Limiting activities for producing fugitive dust particle within project area</li> <li>Vegetation clearance and base stripping should be minimized.</li> <li>Vehicle speed restriction must be</li> </ul>	<ul style="list-style-type: none"> <li>Periodic air quality monitoring in and around the project sites is being conducted and checked it with ECR, 2005 standard.</li> <li>Daily 3-4 times water spraying in the project site.</li> </ul>	<ul style="list-style-type: none"> <li>Partially complied</li> <li>Use of musk as PPE to the labours during working hours</li> <li>Adequate setback distance should be kept</li> </ul>	<ul style="list-style-type: none"> <li>Daily monitoring of dust suppression activities including water spraying is needed for maintaining the air quality within standard limit;</li> </ul>

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		<p>enforced to control dust generation.</p> <ul style="list-style-type: none"> <li>• Earthen roads and undeveloped roads should be avoided to minimize dust generation</li> <li>• Construction materials must be covered to protect from wind action</li> <li>• Spray water regularly for suppressing fugitive dust</li> <li>• Dust particle generated from access road must be controlled by spraying water during dry season.</li> <li>• Stock piles of construction materials must be covered in order to protect from wind action.</li> <li>• An appropriate freeboard must be maintained in trucks hauling construction materials.</li> </ul>	<ul style="list-style-type: none"> <li>• Substantial warning sign especially speed limit was not observed at the strategic locations especially at the approach road.</li> <li>• Covering of some of the stockpiles but watering them as and when required.</li> <li>• Cement debagging process has been done at godown</li> <li>• Wet earthen materials are transported instead of dry sand and silt</li> <li>• Adequate setback distance is not being maintained between stock piles and water bodies especially in the jetty area.</li> <li>• Lack of use of the dust mask to the worker</li> </ul>	for conserving the nearby waterbody from pollution	<ul style="list-style-type: none"> <li>• May use Method 22 for visual inspection of dust at construction site.</li> <li>• Clear the mud over the paved roads</li> <li>• Maintain daily track records of EMP implementation especially water spraying at the source construction yard.</li> </ul>
3	Water Quality	<ul style="list-style-type: none"> <li>• Surface water must be saved from any harmful effluent emission and waste dumping from project site</li> <li>• Provide closed system facilities and wastewater treatment plant to minimize discharge of effluents from worker's colony.</li> <li>• Good housekeeping at workshop and construction site</li> <li>• Appropriate equipment with safety measures should be used for storage and handling of lubricant</li> </ul>	<ul style="list-style-type: none"> <li>• Drainage system has been improved and permanent drainage system at the North-east corner of the Project area has already been operated.</li> <li>• EPC contractor is checking the water quality of outfalls on monthly basis through their HSE supervisors.</li> <li>• Adequate sanitary toilets have been constructed at the labor sheds except one.</li> </ul>	<ul style="list-style-type: none"> <li>• Maximum complied</li> <li>• Manage the waste water from the labour shed</li> <li>• Limit the construction liquid waste</li> </ul>	<ul style="list-style-type: none"> <li>• Clean the vehicles especially the wheel and body from earthen materials weekly</li> <li>• Groundwater should not be withdrawn without taking permission from appropriate authority</li> </ul>

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		<ul style="list-style-type: none"> <li>Provide training and awareness building program to the workers during construction. The training and awareness programs are:               <ol style="list-style-type: none"> <li>Arrange weekly consultation session among the workers through plant site managers. The duration of consultation is one hour according to ISO-14001 standard,</li> <li>Arrange monthly environmental meeting among the mid-level officers through top management when those issues will be discussed under guidance of ECR 1997.</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>Onsite sanitation facilities have been developed at the labor sheds.</li> <li>Training and awareness program are being continued.</li> <li>Drainage system is being maintained properly.</li> <li>No waste water treatment plant or waste water management system was found available for treating the discharged waste water from labor shed</li> <li>Surface run-off was seen carried floating construction wastes, oil and grease</li> <li>Ground water is being withdrawn near the RO plant of ABM Company.</li> </ul>		
4	Waste Generation	<ul style="list-style-type: none"> <li>Limiting site clearance and base stripping activities within the project boundary.</li> <li>Gathering and stocking of construction materials and machinery must be within a limited area in the project boundary.</li> <li>The project area has to be fenced prior to initiation of construction activities.</li> <li>Stock piles of construction materials requiring cover up in order to protect them from wind</li> </ul>	<ul style="list-style-type: none"> <li>Heavy equipment and mechanical equipment are kept in the demarcated places.</li> <li>Solid waste collection process have been systematically arranged</li> <li>Waste bins are installed without color code at different strategic points;</li> <li>Burning of waste materials was not observed.</li> <li>BIFPCL has engaged a company named Rahman</li> </ul>	Maximum Complied	<ul style="list-style-type: none"> <li>The number of Waste Disposal Bin/s with labelling should be increased at labor shed, and at working area.</li> </ul>

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		<p>and weathering action.</p> <ul style="list-style-type: none"> <li>• The existing right of way have to be used for material transportation without creating any block</li> <li>• Location of spoil stock pile ought to be located in safe area and protected from wind and rain action.</li> <li>• No spoil store on River bank/slope</li> <li>• Construction wastes must be reused or recycled as and where possible</li> <li>• Burning of waste material should be restricted</li> <li>• Quality housekeeping practice must be maintained by regular inspection and checking.</li> <li>• Keep onsite waste collection and disposal facilities</li> <li>• Keep provision of different colored waste bin for dumping biodegradable, reusable and recyclable wastes.</li> <li>• Keep provision of awareness building meeting and training for employees</li> </ul>	<p>Brothers in collaboration with the Khulna City Corporation (KCC) for safe disposal of waste materials form project site.</p> <ul style="list-style-type: none"> <li>• Iron and food packages are separated at sources of waste generation</li> <li>• Waste management disposal has been included into the induction training of the labor</li> <li>• Local language (Bengali) are being included in the signboards.</li> <li>• Construction materials and excavated soil were found stored near the river bank.</li> <li>• Licensed has been taken from the department of explosive, fire and safety for storing petro - chemicals</li> <li>• Colored waste disposal bins for different types of waste were not observed during the field visit.</li> </ul>		
5	Compensation and Resettlement	<ul style="list-style-type: none"> <li>• Proper resettlement action plan and compensation plan if the Project needs any land acquisition addressing compensation, restoration, livelihood, living</li> </ul>	<ul style="list-style-type: none"> <li>• Compensation has been given to the rightful owners of the land as per the laws of Bangladesh e.g., 'Acquisition and Requisition of Immovable</li> </ul>	In the process of Compliance	<ul style="list-style-type: none"> <li>• The CSR activities should be oriented towards the affected people or household;</li> <li>• Trained to the</li> </ul>

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		<p>standards etc. based on proper socio-economic studies.</p> <ul style="list-style-type: none"> <li>• Resettlement of the PAPs</li> <li>• Cash for compensation of land (CCL) before resettlement formal agreement with the affected people prior to migration/resettlement</li> <li>• Sufficient standing crop compensation</li> <li>• Compensation for movable structures</li> <li>• Retention of salvageable materials</li> <li>• Compensation for loss of trading income one-time moving assistance grant to cover loss of regular wage income</li> <li>• Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio-economic studies?</li> <li>• Human provide/ take extra care/caution for the disadvantaged/ vulnerable group/s (i.e. women, children, ethnic minorities, indigenous people etc.)</li> <li>• Provision of monitoring the compensation and resettlement process</li> </ul>	<p>Property Ordinance, 1982'.</p> <ul style="list-style-type: none"> <li>• Compensation was paid by the local DC office.</li> <li>• Local DC office facilitates unauthorized occupants of land in the Project area to obtain house in cluster villages provided by the GoB.</li> <li>• Almost 32 affected families are now having their houses at Foyla cluster villages.</li> <li>• BIFPCL is giving priority to affected people in Project related employment.</li> <li>• A significant number of affected people (especially who deserve) are working at the construction site.</li> <li>• 136 indirectly affected people were given compensation by the DC Office, Bagerhat.</li> <li>• One third of the labor has been recruited from the local which include the PAPs.</li> <li>• Livelihood Restoration Plan (LRP) for the PAPs has been prepared by BPDB.</li> <li>• Two local NGOs has contributed for developing the livelihood of the PAPs as per the recommendation of LRAP</li> </ul>		<p>Sundarbans dependent livelihoods group as a part of CSR activities</p>



Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
			<p>and DoE approval conditions.</p> <ul style="list-style-type: none"> <li>In the meantime, around 17 families have got their residence who have shifted their houses from project area to Kapashdanga yet now.</li> </ul>		
6	Livelihood and living condition	<ul style="list-style-type: none"> <li>The labor recruitment policy must be formulated in such a way that the local laborers can easily get the chance of employment in the project work force.</li> <li>Govt./NGOs need to provide support the skill development program and income generation activities to local people;</li> <li>For the increased movement of people and heavy vehicles, the road networks must be developed.</li> <li>Keep provision of sanitary toilet, one toilet for 10 persons.</li> </ul>	<ul style="list-style-type: none"> <li>BIFPCL is maintaining the liaison especially with the local Government and DC office.</li> <li>BIFPCL are recruiting the local people or PAPs with the help of local government.</li> <li>The EPC contractors also deployed Environment and Safety officer for better management of construction works</li> <li>Accidental log sheet or injury log book are being maintained and report is being regularly sent to DOE.</li> <li>One third of the total labor are recruited from the local areas.</li> <li>Most of the local labors are directly project affected people and from nearest communities or from the Rampal/Mongla area of Bagerhat District.</li> <li>The wage of the labor is compatible with the national standard.</li> </ul>	In the process of Compliance	<ul style="list-style-type: none"> <li>Training and motivational program should be run for the worker initially and regularly</li> <li>Disclose the additional initiatives that has been taken for the safety at working place.</li> <li>Evaluation and monitoring of the workplace safety situation</li> </ul>

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
			<ul style="list-style-type: none"> <li>Available drinking water, sanitation facilities, prayer room are provided at site.</li> <li>No incident has been recorded in this quarter</li> </ul>		
7	Green House Gas Controlling Measures	<ul style="list-style-type: none"> <li>Restriction of any kind of solid waste disposal</li> <li>Approved pollution control devices to be fitted in equipment and machinery.</li> <li>Transport vehicles must not be overloaded.</li> <li>Avoid queuing of vehicles in areas adjacent to site, particularly near sensitive receptors including housing.</li> <li>Switch off / throttle down all site vehicles, water vessels, generator and machinery when not in use.</li> <li>Regular maintenance of water vessels, vehicles, generator and machinery in accordance with manufacturer's</li> </ul>	<ul style="list-style-type: none"> <li>Fitness certified vehicles are running for the construction works</li> <li>The EPC Contractor using relatively new equipment and vehicles to reduce the GHGs emission.</li> <li>Equipment, generators and vehicles were observed switched off during non-operation period.</li> <li>Vehicles are not kept at the stand regularly</li> <li>Vehicles are maintaining the road safety regulations.</li> </ul>	In the process of Compliance	<ul style="list-style-type: none"> <li>GHGs inventory checklist should be prepared immediately at this stage;</li> <li>Energy efficient component like light, AC, equipment is to be used for the project purposes</li> </ul>

Table 5.1: Monitoring of Environmental and Social Management System Action Plan Implementation (continued)

Table 5.2: Monitoring of Labor and Working Condition

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
1	Working Conditions and Management of Worker Relationship	<ul style="list-style-type: none"> <li>Preparation of Human Resources Policies and Procedures for Direct workers;</li> <li>Defined Working condition and Terms of Employment for direct worker;</li> <li>Sustainably equivalent terms and condition for migrant workers;</li> <li>Compliance to national law of forming workers' organization;</li> <li>No discrimination and equal opportunity for all;</li> <li>Grievance Redress Mechanism.</li> </ul>	<ul style="list-style-type: none"> <li>BIFPCL is run through the HR polices and switching their professionals as per demand of the project.</li> <li>EHS department strictly monitoring the occupational safety as no accident has been recorded this quarter;</li> <li>EPC contractor deployed OHAS Company has been working nicely for occupational safety.</li> <li>No forced and child labor was recorded;</li> <li>BIFPCL has instructed the EPC Contractor and sub-contractor to ensure safer workplace;</li> <li>BIFPCL has ensured minimum wage and working hours for the labor as per GoB rules and regulation.</li> <li>Induction training and regular training of first aid, toolbox are being continued strictly.</li> <li>No discrimination and equal opportunity of employment for local and migrated labors have been ensured following the 'Bangladesh Labor Law (Revised) 2013', 'Bangladesh Labor Rule, 2015'.</li> <li>Contractor has taken insurance policy for engaging labors as per labor policy of Bangladesh.</li> </ul>	Being Complied	<p>OHAS must be monitored the training for construction workers to protect from-</p> <ul style="list-style-type: none"> <li>Falls (from heights);</li> <li>Trench collapse;</li> <li>Scaffold collapse;</li> <li>Electric shock and arc flash/arc blast;</li> <li>Failure to use proper personal protective equipment; and</li> <li>Repetitive motion injuries.</li> </ul> <p>To develop labour association protecting labour interest</p>
2	Protecting Work Force	<ul style="list-style-type: none"> <li>The client will not employ children in any manner that is</li> </ul>	<ul style="list-style-type: none"> <li>EPC contractors and sub-contractors are not employing any child labor in the</li> </ul>	Being complied	<ul style="list-style-type: none"> <li>The insurance policy should cover the</li> </ul>

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		<p>economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child health or physical, mental, spiritual, moral, or social development.</p> <ul style="list-style-type: none"> <li>No Forced Labor</li> </ul>	<p>project area.</p> <ul style="list-style-type: none"> <li>No forced labor has been recorded in the project.</li> <li>Proper documentation of contract with the worker is being maintained which includes working hour, wage and benefit.</li> <li>First Aid support is provided to the labors as required.</li> <li>The revised ERP has been followed during the construction process.</li> </ul>		<p>accidental case or injuries of the labors;</p> <ul style="list-style-type: none"> <li>Awareness work should be continued regarding the local cultural values, STD, redressing of workers grievances, insurance policy related facilities and also contract clauses of the job to get maximum benefit.</li> </ul>
3	Safety at site	<ul style="list-style-type: none"> <li>Installation/Construction of Safety Fence around the Project area</li> <li>Use of Personnel Protective Equipment's (i.e. safety vest, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.);</li> <li>Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.);</li> <li>Practice of Tool box meeting, safety talks</li> <li>Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.);</li> <li>Maintaining Material Safety Data Sheet (MSDS);</li> <li>Provision of Health care facilities such as doctor, hospital</li> </ul>	<ul style="list-style-type: none"> <li>BIFPCL has demarcated the specific construction site with warning sign;</li> <li>Regular training and awareness program are being maintained strictly.</li> <li>Most of the Labor and Project personnel are using appropriate PPEs like reflecting vest, helmet, and safety shoes etc. except the dust musk.</li> <li>Road traffic management including traffic movement are ensured at access road of the project area.</li> <li>Increased the capacity of temporary hospital, doctors and 24hr availability of ICU supporting ambulance at the Project site;</li> <li>Emergency contact address was found on the board at the site for any kind of sudden incident;</li> <li>EPC has made a contract with the Gazi</li> </ul>	Being Complied	<ul style="list-style-type: none"> <li>Try to develop the habit of the worker for safety worker like protecting the dangerous part of machine, vigilant for moving cranes, hooks or other lifting equipment, fall protection, extra-attention on electrical works etc.</li> </ul>

Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
		etc. available at/nearby the Plant construction site; • Availability of First Aid at work place; • Preparation and Follow of Emergency Response Plan (ERP); • Adequate fire precautions in place (e. g., fire extinguishers, escape routes etc.); • Documentation and reporting of occupational accidents, diseases, and incidents; • Policies and procedures for managing and monitoring the performance of third-party employers in relation to OHS	Medical of Khulna city for emergency medical support. • Construction work at site has been performed in presence of safety officer. • Fire extinguisher was found at required places. • Occupational Health and Safety issues are being supervised by the third-party service. • Weekly checking of all the safety records and implementation of HERA and JSA at site. • Safety and security systems of the project is being maintained by Bangladesh Ansar. They are also maintaining the register and gate pass.		
4	Occupational Health and Safety procedure	• Provision of complete EHS division in the Human Resources Planning/ Organogram • Preparation of Safety Policy to be adopted during Plant operation	• BIFPCL have separate EHS division incorporating environmental specialist, safety officer, firefighting officers, public relation officers, doctors etc • Adequate number of safety officers have been employed by the, EPC contractor and Sub-contractors. • Functioning the revised occupational safety procedure. • Medical aid, fire extinguisher, PPEs are provided adequately. • Adequate workers shed and sanitation facility has been developed; • Onsite medical facilities have been	In the process of Compliance	• Awareness build-up, strict to the safety issues, empower and responsible the safety officers at site. • Continued the safety training, buildup the awareness and make the labour habituated with the safety procedure



Sl. No.	Potential Impacts	EMP measures as proposed in the EIA	Actual measures already Implemented	Compliance Status	Recommended Action
			<p>improved and EPC contractor has made agreement with the government or Private hospital for severe injuries.</p> <ul style="list-style-type: none"> <li>• BIFPCL has already established a Health unit and BHEL has established a full-fledged EHS unit.</li> <li>• Site-specific Environmental Health &amp; Safety checking is being continued.</li> </ul>		
5	Workers Well Being	<ul style="list-style-type: none"> <li>• Provision of Welfare facilities for Worker/Labor such as, timely bonuses, wage, overtime, sick leaves, vacations etc.;</li> <li>• Routine medical check-up and emergency medical care for the sick and injured;</li> <li>• Appointment of a leader amongst the labor group, who will look into workers' well-being.</li> </ul>	<ul style="list-style-type: none"> <li>• Workers are generally satisfied with the working condition and the residence facilities.</li> <li>• BIFPCL has developed apps <a href="https://bifpcl.com/safety.aspx">https://bifpcl.com/safety.aspx</a> for stepping up the safety issues well.</li> <li>• BIFPCL has ensured the benevolent grant developed by the contractor for the victim's family as per Government' rule.</li> <li>• Community People are also taking medications from the BIFPCL medical camp.</li> <li>• Grievance of the workers have been redressed especially for safety issues.</li> </ul>	Being Complied	<ul style="list-style-type: none"> <li>• Freedom of Association, Rights &amp; scope of bargaining should be open for the workers.</li> <li>• The proponent has to look after the following issues – equal benefit for the direct labor, contracted labor, day labor etc., emotional support and health surveillance.</li> </ul>

**Table 5.3: Monitoring of Community Health, Safety and Security**

SI no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status
1	Disturbance to nearby community due to dust from developed land and Noise from construction activities	<ul style="list-style-type: none"> <li>• Construction of boundary wall around the Project area;</li> <li>• Installed water spraying system to control dusts;</li> <li>• Conducting dust monitoring and visual inspection around the site boundary;</li> <li>• Adopted noise management plan.</li> </ul>	<ul style="list-style-type: none"> <li>• Boundary wall has been constructed around the project area.</li> <li>• Water spraying has been made to reduce the dust emission.</li> <li>• CEGIS is routinely communicating with the nearby communities for assessing impacts and related complaints on dust generation issue.</li> <li>• Regular communication and consultation are taken places with the local government and local administration officials.</li> <li>• Environmental parameters are continuously monitored in and around the project site by separate entities.</li> </ul>	Being complied
2	Grievance of local people	<ul style="list-style-type: none"> <li>• Availability and operation of Grievance Redress Mechanism;</li> <li>• Maintaining open communication channel with the local community.</li> </ul>	<ul style="list-style-type: none"> <li>• Social liaison officer is working for developing relation with local communities especially the CSR activities</li> <li>• BIFPCL regularly display the progress of the development through their website (<a href="https://www.bifpcl.com/">https://www.bifpcl.com/</a>) and disclosure meeting at the local government</li> <li>• Local Government and local administration are visiting the site as and when they desire.</li> <li>• Grievance register has been placed at the BIFPCL main office inside the project boundary.</li> <li>• BIFPCL is also receiving grievance from local community through local government like Union Chairman or Local Administration</li> <li>• Proponent is observing the community grievance or quarries though the monitoring study conducted by CEGIS or local government</li> </ul>	Being complied

SI no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status
3	Risk of breaching Community Safety	<ul style="list-style-type: none"> <li>• Construction of boundary wall/safety fence around the Project area;</li> <li>• Practicing Risk Assessment and Evaluation Process;</li> <li>• Practicing safe management for hazardous materials which may pose threat to the community;</li> <li>• Availability and operation of Emergency Response Plan;</li> <li>• Maintaining open communication channel with the local community;</li> <li>• Training and instruction to the security personnel about their behavior and communication with the local people;</li> <li>• Aware the security personnel about the right of the community people.</li> </ul>	<ul style="list-style-type: none"> <li>• Implement adequate security system for protecting the dust and other pollution outside to the project area.</li> <li>• Health check-up is mandatory to every labor during the induction training and medical facilities are available every time.</li> <li>• Maintaining communication with local community regarding their grievance about the worker and work facilities.</li> <li>• Community people is now receiving routine (twice in every week) medical checkup with essential medicine facilities from BIFPCL and specialized medical camp nearby village.</li> <li>• The medical camp initiative was so popular that the local government are demanding more free medical camps.</li> <li>• The proponent is also contributing fund from CSR for training, lab development at Digraj college, RO drinking water supply at Mongla which is supplying 1000 liter fresh water per hour and arranged football tournament, gift to the bright student, school lab development etc to make a congenial relation with the communities.</li> </ul>	Being complied
4	Community Health and Risk	<ul style="list-style-type: none"> <li>• Provision of providing health service facilities to community if the Project poses any health risk like sexually transmitted disease, contract disease, vector-borne diseases;</li> <li>• Implement all pollution mitigation measures to ensure safeguarding to community.</li> </ul>	<ul style="list-style-type: none"> <li>• Developed the medical facilities (consisting medical officer, medical assistant, office assistant) at Plant site for screening of communicable diseases of the workers and staffs;</li> <li>• Arranging twice a weekly health service program (medical consultation and free medicine) for the local community.</li> <li>• A total of 46,767 people has been received medical assistance from BIFPCL where a total of 39872</li> </ul>	Being Complied

SI no	Potential Impacts	Proposed EMP	Actual measures already Implemented	Compliance Status
			<p>people received regular treatment and 3234 people revived medical assistance from monthly campaign.</p> <ul style="list-style-type: none"> <li>EPC contractor is educating to the labors about protective action taken to avoid vector borne diseases and HIV positives.</li> </ul>	
5	Youth Employment (Local)	<ul style="list-style-type: none"> <li>Providing training/awareness program for the local youth to let them aware about the required qualification to get involved in the Project related activities Emphasis to recruit local labors according to their skills and capacities.</li> </ul>	<ul style="list-style-type: none"> <li>Informal and formal sitting were arranged with the local government and community representatives for labor recruitment;</li> <li>Significant number of local people (one third) are currently working at the construction site;</li> <li>The proponent has already taken a number of initiatives to encourage local students through awarding them scholarships.</li> <li>Formal training on computer and sewing machine is running with the youths.</li> <li>BIFPCL has communicated with BITAC, Khulna office for the training of local youths on welding.</li> </ul>	Being Complied
6	Public Communication, Consultation and Awareness	<ul style="list-style-type: none"> <li>Arranging public communication/consultation meeting;</li> <li>Sharing of Project information with local people;</li> <li>Organizing environmental and social awareness programs/meetings.</li> </ul>	<ul style="list-style-type: none"> <li>The project authority is Displaying Project related information on a display board at Project site;</li> <li>Regular meetings are being carried out at different level;</li> <li>Project related every updated information has been uploaded in BIFPCL website (<a href="https://www.bifpcl.com/">https://www.bifpcl.com/</a>)</li> <li>The local people are well aware regarding the project activities.</li> </ul>	Being Complied

Table 5.4: Monitoring of Biodiversity and Sustainable Management of Living Natural Resources

SI No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
1	Rainfall runoff from the construction site would cause deterioration of aquatic ecosystem.	<ul style="list-style-type: none"> <li>• Installation of proper runoff drains;</li> <li>• Use of sediment fences, traps and basins for trapping the sediment, if required.</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of permanent drainage system to discharge water from the project area.</li> <li>• The connectivity of Maidara River is being maintained.</li> <li>• EPC Contractor is monitoring the water quality on monthly basis at every outlet of the project site.</li> <li>• Solid waste has been managed by third parties and finally disposed to the KCC disposal areas</li> </ul>	Being complied	<ul style="list-style-type: none"> <li>• Water quality at every outlet of the project site should be maintained within the standard limit.</li> </ul>
2	Disturbance to nearby ecosystem due to different construction activities	<ul style="list-style-type: none"> <li>• No cutting/ felling of trees along the river bank;</li> <li>• Implementation of onsite waste and air quality management plan;</li> <li>• Limiting soil extraction activities within the defined area;</li> <li>• Limiting the vegetation clearance and base stripping process within the Project boundary;</li> <li>• Safety fence around the construction site;</li> <li>• Limiting the use of night light;</li> <li>• Using shade (directed downwards) around the</li> </ul>	<ul style="list-style-type: none"> <li>• Project activities are limited within the project boundary.</li> <li>• Limiting the vegetation clearance within the Project boundary especially around the ash impoundment.</li> <li>• Plantation program is in progress with the help of forest department.</li> <li>• The client will plant gradually 65,000 local species plant for green belt development.</li> <li>• Selection of local plant species like Goalpata, Sundori, Bain, Keora for green plantation;</li> <li>• BIFPCL has made a contract</li> </ul>	Being Complied	<ul style="list-style-type: none"> <li>• Regular monitoring of the planted trees should be continued around the Project site. Initiatives should be taken to achieve the target of plantation at schedule time.</li> <li>• Reduce the rate of plant dying at the sapling stages.</li> <li>• Bird sheds shall be created at the green belt areas.</li> </ul>



SI No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		outdoor lights; • Provision of cut-off time to switch off unnecessary lights at night; • Initiate Green plantation; • No plantation of non-native species; • Retaining top soil for future habitat restoration; • No degradation of sensitive habitat.	with the Forest Department to plant 5 lakh tree at the end of construction phase. • Motivated the trainees to protect local fauna during training session. • They are maintaining the EMP for protecting the adjacent ecosystem • No alien species has been recorded • Employees are aware about the rescues of species and no harm to wild species		
3	Disturbance to river, inter-tidal areas and wet lands	• No encroachment of inter-tidal flood plain area; • No disturbance to Dolphin community; • Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health; • If required, embankment should be constructed considering a setback distance from river/canal bank; • Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come, and; • BIFPCL may take initiatives of	• Monitoring of ecosystem health of Sundarbans, and around the Project site is being continued; • Maintaining the slope protection and other development works; • EPC Contractor is monitoring the discharged water quality at each of the outlet from this project on a monthly basis. • The project authority is constructing the permanent jetty as per approved layout. • Slope protection work along the Maidara River has been completed;	Being Complied	• Monitoring is to continued for dumping of any construction materials or scrap materials to the nearby river. • Initiatives should be taken for excavation of silted reach of Maidara river near the proposed township area to facilitate proper functioning of River for maintaining tidal flow dynamics

SI No	Potential Impacts	EMP measures as proposed in the EIA	Actual condition/ Measures already Implemented	Compliance Status	Recommended Action
		excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal flow dynamics			

## 5.2 Compliance to the Conditions of DoE

SI No	Condition of DoE	Compliance Status	Remarks
1	This EIA Report is approved only for 1320 MW Khulna Coal Based Power Plant. Any expansion or extension of this Power Plant will require obtaining further Environmental Clearance with additional EIA Study.	BIFPCL has not taken any extension plan of the 2x660 MW Maitree Super Thermal Power Plant.	BIFPCL will comply with the condition prior to initiation of any expansion or extension of the Power Plant.
2	The Coal Specification and Power Plant technology should be maintained as per EIA report. In case any change in design the proponent must obtain consent from DoE.	The Coal Specification and Power Plant technology will be maintained as per EIA report. In case of any change in Plant design and coal specification the proponent shall have to obtain consent from DoE.	Suggested to comply as and when required.
3	Project Proponent may undertake activities for land development and infrastructural development of the Project.	BIFPCL has already completed land development activities for the block –A area. Infrastructure development activities in the Project are in progress.	Complied.
4	Project Proponent may open L/C (Letter of Credit) for importing machineries for the Project, which shall also include machineries relating to waste treatment plant and other pollution control devices.	EPC contractor has already been appointed and Equipment & machineries are being imported as per contract.	Being Complied.
5	The activity under Proposed Khulna 1320 MW Coal based Thermal Power Plant Construction and operation shall not release any pollutant that affect human health or will have damaging impact on the environment or natural resources.	BIFPCL engaged CEGIS as an independent entity for monitoring the construction activities for examining environmental impacts on quarterly basis. No significant impact of Power Plant activities on the surrounding environment or on the natural resources has been reported yet. All necessary pollution control measures and technologies i.e. Effluent Treatment Plant, ESP, and FGD etc. have already been incorporated in the technical specification of	Being Complied.

SI No	Condition of DoE	Compliance Status	Remarks
		main Plant of EPC package as per DoE stipulations. The EPC contractor is constructing the Plant as per the contracted technical specification. Moreover, environmental compliance monitoring is also being continued in the project site in order to record emission or discharge pollution from project on monthly and quarterly basis.	
6	Proper and adequate mitigation measures shall be ensured throughout preparation, construction and operation period of the proposed Khulna 1320 MW Coal based Thermal Power Plant Project activities.	BIFPCL is monitoring the mitigation measures on a quarterly basis as per EMP. As a third-party monitor, CEGIS has been appointed to monitor the mitigation measures adopted by the proponent during construction stage.	Being Complied.
7	Any heritage sight, ecologically critical area, and other environmentally, religious and archaeologically sensitive places shall be kept protected during Project construction phase.	There is no religious, archaeological place in and around the site. A quarterly monitoring program has been monitored the potentially project influence area of the Sundarbans Reserve Forest, Ecologically Critical Area and World Heritage Site as per the guidance of DOE and FD.	Being Complied.
8	Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding & nursery sites.	The quarterly monitoring results reveal no noticeable impacts on fish habitats and fish breeding, feeding & nursery sites.	Being Complied.
9	Construction works shall be restricted to daytime hours so as to avoid/mitigate the disturbance of local lives as well as implementation schedules of the works shall be notified in advance to nearby residents.	CEGIS is monitoring the community response towards construction works of Power Plant regularly. Moreover, BIFPCL is keeping close communication with local government institute to receive their grievance related to project activities. For the timely completion of the Project, if required, works may be continued beyond day time, but that must be done within the project boundary avoiding any disturbance of local lives as well as notifying the implementation schedules of the works in advance to nearby residents.	Suggested to comply for the remaining period of construction works.
10	Proper and adequate sanitation facilities shall be ensured in labor camps throughout the proposed Project period.	New residential areas and adequate sanitation facilities are becoming available for the workers. Provisions in line with this, condition have been included in Clause no 2.5 of Special Condition of Contract (SCC) and in Health & safety manual. Adequate sanitation facilities are recorded at the labor camps.	Being Complied
11	In order to control noise pollution, vehicles &	All vehicle & equipment used at site are under regular	Being Complied

SI No	Condition of DoE	Compliance Status	Remarks
	equipment shall undergo regular maintenance; working during sensitive hours and locating machinery close to sensitive receptor shall be avoided.	maintenance. Working during sensitive hours like night time and locating machinery close to sensitive receptor like near the labor camps are being tried to avoid or managed through appropriate measures.	
12	No solid waste can be burnt in the Project area. An environment friendly solid waste management should be in place during the whole period of the Project in the field.	No solid waste is burnt inside the project boundary. Provisions in line with this, condition have been included in Clause No 14.9 of SCC. Solid Waste Management system has been prepared (Section-V, B12, and Part-9 of Technical Specification). However, solid waste is being managed systematic process with the assistance of KCC at this stage.	Being complied
13	Proper and adequate on-site precautionary measures and safety measures shall be ensured so that no habitat of any flora and fauna would be endangered or destructed.	Quarterly monitoring activities are being carried out to examine the impacts. No significant changes are yet recorded. Moreover, monthly environmental monitoring has been performed for noting any harmful emission or discharge pollution from project.	Being Complied
14	All the required mitigation measures suggested in the EIA report along with the emergency response plan are to be strictly implemented and kept operative / functioning on a continuous basis.	The project authority has increased the medical facilities for workers. An ICU supported ambulance and Doctor has been made available for emergency stages for both BIFPCL and EPC contractor. They have made a contract with government or private hospital for emergency medical services. Periodic training has been made as mandatory for the workers.	Being Complied
15	To control dust, spraying of water over the earthen materials should be carried out from time to time.	Periodic air quality monitoring in and around the project sites is being conducted and checked it with ECR, 2005 standard. Four water tanker are dedicated for sprinkling water substantially.	Being Complied
16	Storage area for soils and other construction materials shall be carefully selected to avoid disturbance of the natural drainage.	BIFPCL authority has selected designated areas for safe storage of construction materials. In addition, BIFPCL has already constructed the permanent drainage system to discharge water from the Project site.	Being Complied
17	Adequate considerations should be given to facilitate drainage system for runoff water from rain/tidal surge.	Adequate considerations have been given to facilitate drainage system for runoff water from rain/tidal surge. They are not interfering any natural drainage system beside the project boundary.	Being Complied.
18	Adequate facilities should be ensured for silt trap to	Regular maintenance is being carried out for avoiding the water	Being Complied.

SI No	Condition of DoE	Compliance Status	Remarks
	avoid clogging of drain/canal/water bodies	clogging in the canal/drainage network especially during monsoon season.	
19	The entire coal handling system should be designed as an enclosed (and not only covered) conveyor system. There should be integrated dust control system with dust extraction and bag filters at unloading areas and at each transfer points on the conveyor system.	Entire coal handling system has been designed as an enclosed conveyor system as per DoE requirement. Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of Main Plant EPC contract package. Refer Section V, B4 of Technical Specification.	Compliance action initiated.
20	Coal Plant should have high-efficiency bag filter for arresting dust emissions.	Integrated dust control system with dust extraction system / bag filter and dust suppression system at crusher house, unloading points, transfer points has been specified in the technical specification of EPC contract. Refer Section V, B4 of Technical Specification (Clause no B4.3.1.4).	Compliance action initiated.
21	Coal should be stored in a covered storage yard.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification (Clause No B4.3.1.6).	Compliance action initiated.
22	The entire coal stockyard should be covered with water sprinkler provided with automated moisture sensor to control self-combustion.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification.	Compliance action initiated.
23	100% utilization of fly ash and bottom ash should be planned and implemented throughout the operation of the Plant. There should only be a provision of small ash dyke that will not exceed 25 (twenty-five) acres of land to store residual ash.	100% utilization of fly ash has been planned and shall be implemented throughout the operation of this Plant. EOI has been received in this regard from nearby Cement Industries. Only 25 acres area has been allocated to store residual ash.	Compliance action initiated.
24	Integrated dry ash handling, loading, unloading and transportation system should be established.	Integrated dry ash handling, loading, unloading and transportation system will be established. Provisions in line with this has been included in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated.
25	There should be adequate and properly sized and designed dry ash silo with appropriate conveyor system.	Adequate and properly sized dry ash silo with appropriate conveying system have been specified in Technical Specification of main Plant EPC contract package (Section V, Chapter B4).	Compliance action initiated



SI No	Condition of DoE	Compliance Status	Remarks
26	Bottom ash should be extracted, crashed and stored in silos for utilization with proper collection and conveyor system.	Bottom ash shall be extracted, crushed and stored in silos for utilization with proper collection and conveying system. The procedures have been included in the technical Specification of EPC contract package. (Section V, Chapter B4).	Compliance action initiated
27	Resettlement and rehabilitation of the displaced population (including those who do not own land) should be done properly.	Land has been acquired as per the legal procedure of GoB. However, BPDB wrote to Ministry for suitable resettlement and rehabilitation as per DoE requirement. In the meantime, BPDB have prepared an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. As per the recommendation of the LRP, one selected NGO "Samahar" has completed the task. Moreover, DC office has rehabilitated around 32 families at Foyla and 17 families at Koigardaskati.	Compliance action initiated
28	Resettlement plan should be properly implemented and people should be adequately compensated.	Land was acquired by GoB. Resettlement and rehabilitation action had been taken as per the law of the Bangladesh. However, BPDB conducted an assessment (Livelihood Restoration Plan) regarding the rehabilitees (including those who do not own land) for this Power Plant. Based on the recommendation of the LRP, local NGO has conducted the training and other tasks to the PAPs. DC office is trying to resettle the PAPs at their selected sites according to the LRP.	Compliance action initiated
29	Construction material should be properly disposed-off after construction work is over.	At present, the construction work is going on. Storage room has been prepared for the construction materials which is shifting regularly for the necessity of work. Solid Waste Management plan has also been prepared keeping the provisions in line with this (Section-V, B12, and Part 9 of Technical Specification). However, solid waste management plan has been drawn following mostly conventional procedure. Now, the solid waste has been managed properly with the assistance of the KCC.	Compliance action initiated
30	As described in the report environmental monitoring should be strictly followed and monitoring report should be shared with DoE to	BIFPCL has engaged CEGIS for conducting environmental monitoring on a quarterly basis in February 2014. Accordingly, each quarterly monitoring report has been prepared, submitted	Being Complied.

SI No	Condition of DoE	Compliance Status	Remarks
	ensure the environmental management properly.	and shared with DoE, which are also available at BIFPCL web site.	
31	All activities (pre-construction, construction and post-construction stage) should be implemented according to EMP clearly listed in the EIA report.	BIFPCL has adopted the EMP suggestions applicable at relevant stages. CEGIS, as an environmental consultant of BIFPCL is monitoring the implementation status of EMP on a quarterly basis. BIFPCL is taking appropriate actions based on EMP monitoring report. After strengthening the OHAS measures, accident at working places is reduced.	Complied at present.
32	A third party/independent monitoring bodies excluding JVC/BPDB should be engaged immediately for monitoring of all activities during pre-construction, construction and operation phases as per monitoring plan of EIA report and monitoring report must be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	CEGIS has been engaged by BIFPCL as an independent monitoring body for conducting environmental monitoring on a quarterly basis since February 2014. From then on, as per the contract, CEGIS has been serving as consultant and conducting the monitoring programs quarterly and producing monitoring reports on quarterly basis which are submitted by CEGIS to BIFPCL for onward submission to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment as directed by DoE.	Being Complied
33	Regular monitoring of the susceptible places of Sundarbans for protecting ecosystem, biodiversity and forest coverage should be made using latest high-resolution image for keeping ambient environment.	The Monitoring activities of CEGIS included monitoring of the susceptible places of Sundarbans. The monitoring report contains analysis of biodiversity and forest coverage. However, in addition to this, Forest Department has also suggested some survey & analysis which have also been monitored and reported by CEGIS through the quarterly monitoring report.	Being Complied.
34	Air, water, soil, biological and social data should be monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The network monitoring system will be installed as a part of the project construction for online monitoring and it will be run at the time of operation of the Power Plant. All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5). However, air, water, soil and biological components are regularly monitored as per recommendation of EMP.	Compliance action initiated.
35	There should be regularly disclosure of the report	CEGIS is regularly carrying out public consultation at different	Being Complied.

SI No	Condition of DoE	Compliance Status	Remarks
	through workshops and websites and responses should be taken care accordingly.	levels. All the monitoring reports are being kept available on website of BIFPCL (www.bifpcl.com)	
36	Online air and water quality monitoring system should be made functional throughout the life of the Plant.	The online monitoring system will be installed when the Plant will be in operation phase and will continue throughout the life time of the Plant.  All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5).	Compliance action initiated
37	Management Information System (MIS) is to be developed for this coal-based Power Plant. The scope of MIS services will obviously include representing the real time monitored data especially environmental parameters displaying at Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment, BPDB and other concerned agencies/Ministries. The MIS should be web based for accessing every individual to show the real time monitored records.	The MIS will be prepared before commissioning of the Plant. The consultant for developing MIS will be engaged at least one year earlier. Specifications of MIS system is already included in EPC contract document. Technical Specification like DDCMIS, DDCS, PADO System, HART system, Plant MMS, Information management security system etc. have been included. Moreover, the proponent is now trying to initiate this system.	Compliance action initiated
38	JVC should provide all sort of logistics support to DoE and other relevant agencies for monitoring environment related items/events.	BIFPCL is ready to provide all sort of logistic support as and when required by DoE and other relevant agencies for monitoring of Plant construction activities and environmental items/events.	Being complied
39	No ground water should be allowed to use for plant purposes.	In compliance of the DoE approval condition no. 39 of EIA Report, "No ground water should be allowed to use for plant purposes". The Power Plant has been designed considering use of surface water only during all stages of project development and operation.  The authority has already installed a Reverse Osmosis (RO) Water Treatment Plant for use of surface water for potable purposes.  Usually, ABM Water (RO) Plant supplies fresh water for	Necessary measures should be taken for regular maintenance and continuous functioning of the RO Water Treatment Plant which assist to comply the DOE approval condition.

SI No	Condition of DoE	Compliance Status	Remarks
		construction and potable purposes after treating the river water of Passur. But during the last compliance monitoring visit, a 1200ft deep tube well has been recorded near the ABM water plant. In this regard, the representative of the Proponent informed the Team that due to sudden malfunctioning and maintenance of the RO Water Treatment Plant and emergency water supply for drinking and firefighting ground water might be required on temporarily basis. BIFPCL informed that the RO Water Treatment Plant is fully operational and the intake water is sourced from the river water of the Passur.	
40	Conduct stakeholder meetings on regular basis for better performance of the Project as a whole.	Pre-construction phase of the Plant has been completed and the construction phase is continued. BIFPCL has appointed a social worker who regularly visits nearby community to consult with the local people. Besides, CEGIS, appointed by the Project authority as environmental monitoring consultant, is also carrying out consultation with the local people on regular basis for better performance of the Project as a whole.	Being Complied
41	Additional Environmental baseline data to be collected as suggested in the EIA report and conveyed to DoE and other concern authorities.	CEGIS has been engaged since February 2014, for preparing Detailed Environmental Baseline. CEGIS has submitted annual monitoring report along with reports of quarterly monitoring containing latest baseline data to BIFPCL for further dissemination to DoE and other concerned authorities.	Being Complied
42	The Environmental Management Plan under the EIA study shall strictly be implemented and kept functioning on a continuous basis.	BIFPCL has been implementing all the EMP measures phase by phase as suggested in EIA report and approval condition of DoE. The status of EMP implementation are also regularly monitored by CEGIS.	Being Complied
43	The Project authority shall submit a detail work plan with time schedule of development activities at least 7 (seven) days ahead of the work commences in the field to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The construction works is now going on. BIFPCL has submitted the detailed work plan seven (7) days before start of the construction activities.	Being complied

SI No	Condition of DoE	Compliance Status	Remarks
44	Environmental Monitoring Reports according to specific format specified in the EIA Report shall be made available simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.	Environmental Monitoring Reports as per specific format provided in the EIA Report made available by BIFPCL and submitted to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters accordingly.	Being Complied
45	The following records must be kept in respect if any samples required to be collected for the purpose of environmental monitoring activities: <ul style="list-style-type: none"> <li>• The date(s) on which the sample was taken;</li> <li>• The time(s) at which the sample was collected;</li> <li>• The point at which the sample was taken; and</li> <li>• The name of the person who collected the sample.</li> </ul>	The Monitoring report keeps all the records as suggested.	Being Complied
46	The results of any monitoring required to be conducted under this EIA report must be recorded.	CEGIS is recording all the monitoring data and submitting to BIFPCL through proper documentation. The report is being shared with DoE on regular basis.	Being Complied
47	In case of any emergency, the following information shall be immediately be reported to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) simultaneously. Nature of incident (oil spill, fire, accident. Collision, land slide, etc.). Personnel affected (injured, missing, fatalities, etc.). Emergency support available and its location (standby transport, medical facilities, etc.). Weather conditions Current operations (abandoning the site, firefighting, etc.)	No single emergency incident happened during this quarter (September -November, 2019). BIFPCL has established strong monitoring activities on safety issues, made penalty on EPC contractor to establish best practices and keep all records for avoiding any incident as like earlier. However, taking numbers of initiatives by the authorities and proponent have collectively reduce the incident in this quarter.	Complied at present
48	The Project authority or its employees must notify the department of Environment of incidents causing or threatening material harm to the environment as soon as practicable after the	So far, no such incident has occurred in this quarter. BIFPCL has established a proper mechanism for recording such incident as suggested and notify the department of Environment regarding incidents causing or threatening material harm to the environment	Complied at present.



SI No	Condition of DoE	Compliance Status	Remarks
	person becomes aware of the incident.	as soon as practicable after the person becomes aware of the incident. Health and safety management manual has been practiced and Environment and Safety Officer has been employed and CEGIS is monitoring the EMP implementation.	
49	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DoE) in Dhaka.	So far, no such incident has happened. BIFPCL has established a proper mechanism for recording such incident as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance on a regular interval.	Being complied
50	Appropriate permission would require to be obtained from the Forest Department in favor of cutting/felling on any plant/tree/sapling forested by any individual or government before doing such type of activity.	There is no need of cutting/felling down of any trees outside the project boundary. However, in future, if any such case arises, BIFPCL would seek for appropriate permission from the Forest Department.	Being complied
51	Re-vegetation and re-plantation under green belt activities shall be undertaken in consultation with the Forest Department according to those mentioned in the EIA report.	An MoU has been signed with Forest Dept., Bangladesh on 24.02.2015 for implementation of Afforestation Program. Initial target is to plant 2 lac saplings in 3 years. By this time, Forest Department has targeted initially to plant about 65000 nos. of saplings of different species. A fresh Agreement with BFD was signed on 24.01.2018 for plantation of 5 Lakh trees for at the end of construction stages.	Being Complied
52	Climate Change impacts and maximum storm surge height shall have to consider at the design and construction phase.	The design level (elevation) of the land and earthen embankment has been designed and constructed considering the climate change impact and maximum storm surge height.	Being Complied
53	A separate EIA/morphological study shall have to be conducted for coal transportation and river dredging to develop sound environmental management plan towards conservation of ecosystem and biodiversity.	Coal transportation will be done through the existing maritime route, which is Mongla Port Authority (_MPA) controlled waterways. M/s. Institute of Water Modelling (IWM) has already completed the EIA study for the dredging activity and submitted the report to MPA. A separate EIA study for Coal Transportation was conducted by M/s. Center for Environment and Geographic Information Services (CEGIS) which has been approved by DoE.	Being Complied.
54	A full-fledged institutional setup for EHS and CSR must be put in place before operation of the Power	A full-fledged institutional setup for EHS activities shall be in place before operation of the Plant (Project). After the consecutive	In the process of compliance

SI No	Condition of DoE	Compliance Status	Remarks
	Plant.	accidents, the EHS process has been drastically re-arranged and reshaped. Therefore, no incident has been occurred during this quarter. Meanwhile, a number of CSR activities are ongoing at Project site, like free medical facilities and medicines, free potable water supply to the local people, medical campaign, training etc. infrastructure development of nearby school.	
55	The Project authority shall extend active cooperation to DoE officials to facilitate their visit to the site as and when necessary.	BIFPCL is extending its all-out cooperation to DoE.	Being Complied
56	Violation of any of the above conditions shall render this approval void.	Noted by BIFPCL	
57	Any injunction on this Project from the Honorable Supreme Court/High Court Division shall render this approval void.	Noted by BIFPCL	
58	Without installation of 275 Meter Height Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system and other pollution control equipment and obtaining Environmental Clearance Certificate, the proponent shall not start operation of the Project.	At present, the Plant is in construction phase. The functional and technical specification of the main Plant includes 275 Meter high Chimney, Effluent Treatment Plant (ETP), Waste Water Treatment Plant (WWTP), Settling Pond, Desalinization Plant, API, Oil Water Separator, High Efficiency Electro Static Precipitator (ESP), 'closed-loop' Flue Gas Desulfurization (FGD), Low NOx Burner, online air and water quality monitoring system for preventing pollution. All these stipulations have been included in the technical specification of Main Plant EPC contract package. Moreover, BIRPCL has got the Environmental Renewal Certificate each of the year through maintaining the conditions of DOE.	Compliance action initiated
59	This EIA Approval has been issued with the approval of the appropriate authority.	BPDB and BIFPCL are thankful to DoE.	

However, with reference to the approval of EIA study of coal transportation for 2x660MW MSTPP having (Memo no: DoE/clearance/ 5532/2016/50, dated 31/01/2018), Department of Environment has set some specific conditions to be followed as a fulfillment of the condition no. 53 of the EIA approval letter of 2x660 MW MSTPP. The conditions and compliance status have been listed as follows-

### 5.3 Compliance to the conditions of DoE (EIA study of Coal Transportation)

Sl. No.	Conditions	Compliance status	Remarks
1	This EIA Report is approved only for Coal Transportation for the Proposed 2x660 MW Maitree Super Thermal Power Plant Project. Any modification of this project as well as Coal Transportation will require further EIA approval with additional EIA Study.	No. modification of this Project as well as Coal Transportation has happened yet. BIFPCL will notify to DOE prior to initiation of any expansion or extension of the Power Plant.	Suggested to comply as and when required.
2	The route of coal Transportation should be maintained as per EIA Report. In case of any changes the proponent must obtain consent from DoE.	The route of coal Transportation will be maintained as per EIA report. In case of any changes in the transportation route, the proponent shall obtain consent from DoE.	Suggested to comply as and when required.
3	Project Proponent may open L/C (Letter of Credit) for importing machineries for the project which shall also include machineries relating to waste treatment plant and plant and other pollution control devices.	EPC contractor has been appointed for this Project. They are importing Power Plant machineries complying the national laws and regulation.	Being Complied.
4	The activity under Coal Transportation for the Proposed 2x660 MW Maitree Super Thermal Power Plant Project shall not release any pollutant that affect human health or will have damaging impact on the environment or natural resources.	BIFPCL engaged CEGIS for monitoring and examining status of the environment or natural resources. So far, no activity under Coal Transportation for the Proposed 2x660 MW Maitree Super Thermal Power Plant Project has been started. So, there is no issue for impact on the surrounding environment or natural resources from the coal transportation activities. Moreover, a strong baseline has been prepared throughout the coal transportation route for assessing the impact in future.	Suggested to comply as and when required.
5	Proper and adequate mitigation measures shall be ensured throughout the operation period of the Project	The project proponent has included all the mitigation measures in their BID document. However, BIFPCL is monitoring the implementation of mitigation measures for the construction period.	Suggested to comply at operation phase.

Sl. No.	Conditions	Compliance status	Remarks
6	Any heritage site, ecologically critical areas, and other environmentally, religious and archeologically sensitive places shall be kept protected during project operation.	There is no Religious and Archaeological place in and around the Project site. As a third party, CEGIS is now monitoring the potential locations and indicators which are sensitive to coal transportation in the Sundarbans Reserve Forest and Sundarbans World Heritage Site	Suggested to comply at operation phase.
7	Environment friendly construction and development practices shall be followed that minimize loss of habitats and fish breeding, feeding and nursery sites.	Development of coal transportation system will be followed through best practices and EMPs of EIA of Coal Transportation Report. Labor/workers are working with environment friendly procedure during construction of power plants including Jetty.	Being Complied
8	Proper and adequate sanitation facilities shall be ensured in labor camps throughout the proposed project period.	At present, the civil construction of the Project including Jetty construction activities are progressing fast. New residential areas and adequate sanitation facilities are available for the labors. Provisions in line with this, condition have been included in Clause no 2.5 of Special Condition of Contract (SCC) and in Health & safety manual.	Being Complied
9	Proper and adequate on-site precautionary Measures and safety measures shall be ensured so that no habitat of any flora and fauna would be endangered or destructed.	The construction of Jetty is being carried as per EMP guidelines. Moreover, regular monitoring activities are carried out to assess the significant changes due to jetty construction activities.	Being Complied
10	All the required mitigation measures Suggested in the EIA report along with the emergency response plan are to be Strictly implemented and kept operative/functioning on a continuous basis.	The proponent is giving top priorities to occupational health and safety issues after few incidents. They have significantly revised the OHAS practices. The proponent must follow the pragmatic site-specific ERP of along with NOSCAP, 2017. There is no incident recorded in this quarter.	Compliance action initiated
11	To control dust, spraying of water over the earthen materials should be carried out from time to time	Water spraying for dust suppression are currently functioning wish is monitoring daily.	Being Complied
12	The entire coal handling system should be designed as an enclosed (and not only covered) conveyor system. There should be integrated dust control system with dust extraction and bag filters	In the BID document, the coal handling system has been mentioned as closed system with the integration of dust control measures. Moreover, continuous monitoring system will be instructed in the EIA	Compliance action initiated

Sl. No.	Conditions	Compliance status	Remarks
	at unloading areas and at each transfer points on the conveyor system.	monitoring section.	
13	Coal should be stored in a covered storage yard.	All these stipulations have been included in the technical specification of Main Plant EPC contract package, Section V, B4 of Technical Specification (Clause No B4.3.1.6).	Compliance Action initiated.
14	The entire coal stockyard should be Covered with water sprinkler provided with automated moisture sensor to control self-combustion.	EIA study of the Power Plant suggested to install water sprinkler in coal stockyard which has been repeated in EIA study of Coal transportation. However, all these stipulations have been included in the technical specification of Main Plant EPC contract package.	Compliance Action initiated.
15	Construction material should be properly disposed of after the construction work is over.	The proponent now preparing an environmentally friendly procedure for disposing off the construction material like scraps as well as other construction wastes. They have already contracted one organization in association with KCC for solid waste management.	Compliance Action initiated.
16	As described in the report environmental monitoring should be strictly followed and monitoring report should be shared with DOE to ensure the environmental management properly.	BIFPCL has engaged CEGIS for environmental monitoring in February 2014. Accordingly, each quarterly monitoring report has been submitted and shared with DoE, which are also available at BIFPCL web site.	Being Complied.
17	A third party/independent monitoring bodies excluding BIFPCL should be engaged immediately for monitoring of all the activities during pre-construction, construction and operation phases as per monitoring plan of EIA report and monitoring report must be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	CEGIS, as an independent monitoring body has been engaged by BIFPCL since February 2014 and still continued. From then on, CEGIS has been conducting the monitoring programs quarterly and producing monitoring reports on regular basis which are submitted by CEGIS to BIFPCL for onward submission to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment as directed by DoE.	Being Complied
18	Regular monitoring of the susceptible places of the Sundarbans for protecting ecosystem, biodiversity and forest coverage should be made using latest high-resolution image for	The Monitoring activities have been carried out by CEGIS. The study includes all of this part vastly. The monitoring report contains analysis of biodiversity and forest coverage. However, in addition to this, Forest	Being Complied.



Sl. No.	Conditions	Compliance status	Remarks
	keeping ambient environment.	Department has also Suggested some survey & analysis which have also have been monitored and reported by CEGIS through the quarterly compliance monitoring report.	
19	Air, water, soil, biological and social data should be monitored regularly with a network monitoring system with a view to assess the natural quality of the Sundarbans and other fragile ecosystem and report of monitoring results should be submitted to Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The network monitoring system will be installed as a part of the project construction for online monitoring and it will run at the time in operation phase. All these stipulations have been included in the technical specification of Main Plant EPC contract package. (Section-V, Clause No B0 6.19.13.2 and Clause No. B0 6.19.13.5).	Being Complied.
20	There should be regular disclosure of the report through workshops and websites and responses should be taken care accordingly.	All of the environmental monitoring reports and other relevant reports are available on website of BIFPCL ( <a href="http://www.bifpcl.com">www.bifpcl.com</a> ). CEGIS is regularly carrying out public consultation.	Being Complied.
21	BIFPCL should provide all sort of logistics support to DOE and other relevant agencies for monitoring environment related items/events.	BIFPCL is ready to provide all sort of logistic support as and when required by DoE and other relevant agencies for monitoring of Plant construction activities and environmental items/events.	Suggested to Comply as and when required.
22	In order to control noise pollution, vessels and equipment shall undergo regular maintenance; working during sensitive hours and locating machinery close to sensitive receptor shall be avoided.	Not applicable in this stage	Suggested to Comply as and when required.
23	Vessels of this project should follow the MPA guidelines and protocol to ensure no hindrance to other vessels.	Not applicable in this stage	Suggested to Comply as and when required.
24	The vessels used for this project should maintain IMO criteria to enable identification of substances harmful to the marine environment.	Not applicable in this stage	Suggested to Comply as and when required.
25	All the vessels should follow applicable MARPOL Convention, Annex V on the prevention of pollution by garbage from ships.	Not applicable in this stage	Suggested to Comply as and when required.
26	Additional Environmental baseline	Environmental baseline data has	Being

Sl. No.	Conditions	Compliance status	Remarks
	data to be collected as suggested in the EIA report and conveyed to DOE and other concern authorities.	been collected by third party i.e. CEGIS. CEGIS has submitted reports of quarterly monitoring containing latest additional baseline data to BIFPCL for further dissemination to DoE and other concerned authorities.	Complied
27	The Environmental Management Plan under the EIA study shall strictly be implemented and kept functioning on a continuous basis.	BIFPCL has so far been implementing the EMP measures phase by phase as suggested in EIA report and approval condition of DoE. The status of EMP implementation are also regularly monitored by CEGIS.	Being Complied
28	The project authority shall submit a detail work plan with time schedule of development activities at least 7 (seven) days ahead of the work commences in the field to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously.	The jetty construction works is now going on. Beforehand, BIFPCL has submitted the detailed work plan seven (7) days before starting of the construction activities to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment simultaneously. They will maintain it in future.	Being complied
29	Environmental Monitoring Reports According to specific format specified in the EIA Report shall be made available simultaneously to DOE Bagerhat District Office, Khulna Divisional Office and Headquarters on a quarterly basis during the project period.	Environmental Monitoring Reports of the Power Plant project including Jetty construction as per specific format provided in the EIA Report made available by BIFPCL and submitted to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters since April, 2018.	Being Complied
30	The following records must be kept in respect of any samples required to be collected for the purposes of environmental monitoring activities: a) the date(s) on which the sample was taken; b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) The name of the person who collected the sample.	The Monitoring report of CEGIS keeps all the records as suggested.	Being Complied
31	The results of any monitoring required to be conducted under this EIA report must be recorded.	CEGIS is recording all the monitoring data and submitting to BIFPCL through proper documentation. The report is being shared with DoE on regular basis.	Being Complied
32	In case of any emergency, the	Emergency Reporting/ Emergency	Compliance

Sl. No.	Conditions	Compliance status	Remarks
	<p>following information shall immediately be reported to Bagerhat District Office, Khulna Divisional office and Headquarters of the Department of Environment (DOE) simultaneously:</p> <ol style="list-style-type: none"> <li>Nature of incident (oil spill, fire, accident, collision, land slide etc.)</li> <li>Personnel affected (injured, missing, fatalities, etc.)</li> <li>Emergency support available and its location (standby transport, medical facilities, etc.)</li> <li>Weather conditions</li> <li>Current operations (abandoning the site, firefighting, etc.)</li> </ol>	<p>response Plan have been prepared for the Power Plant which includes the Jetty. Health and safety management manual have been revised for better and precautions implementation of OHAS. They have taken a lot of care regarding occupational health and safety. BIFPCL will adopt the ERP suggested on the EIA study of coal transportation in association with the NOSCOP and NPDM for any future incidents as suggested.</p>	Action initiated.
33	National Oil Spill Contingency Plan (NOSCOP) should be followed to establish an organizational structure to combat marine pollution	Not applicable in this stage	Suggested to comply as and when required.
34	The project authority or its employees must notify the Department of Environment of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.	BIFPCL has established a proper mechanism for the project to record such incident as suggested and notify the department of Environment regarding incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident. They will prepare the institutional arrangement for managing the incident during coal transportation system before the operation. Moreover, monitoring activities is continued for any significant changes in natural ecosystem.	Complied at Present.
35	All pollution incidents shall be reported immediately and simultaneously to the Bagerhat District Office, Khulna Divisional Office and Headquarters of the Department of Environment (DOE) in Dhaka.	BIFPCL has established a proper mechanism for recording such incidents as suggested in the ERP. CEGIS has been engaged to monitor the social and environmental compliance monitoring on a regular interval.	Complied at Present.
36	Climate Change impacts and maximum storm surge height	The design level (elevation) of the land and earthen embankment has	Being Complied

Sl. No.	Conditions	Compliance status	Remarks
	shall have to consider at the design and construction phase of the jetty.	been fixed considering the climate change impact and maximum storm surge height.	
37	The transshipment point Faraway Buoy at the Bay should be used from November to March, and Mazhar point should be used from April to October every year for transporting coal which has been mentioned in the EIA Report.	Not applicable in this stage	Suggested to comply as and when required.
38	Violation of any of the above conditions shall render this approval void.	Noted by BIFPCL	-
39	Any injunction on this project from the Honorable Supreme Court/High Court Division shall render this approval void.	Noted by BIFPCL	-
40	This EIA approval is valid for one year from the date of issuance and the project authority shall apply for renewal to the Bagerhat District Office of DoE at Bagerhat with a copy to Head Office of DOE in Dhaka.	The authority is maintaining the renewal process as suggested. As like previous years, BIFPCL has got the renewal for this year.	Being complied

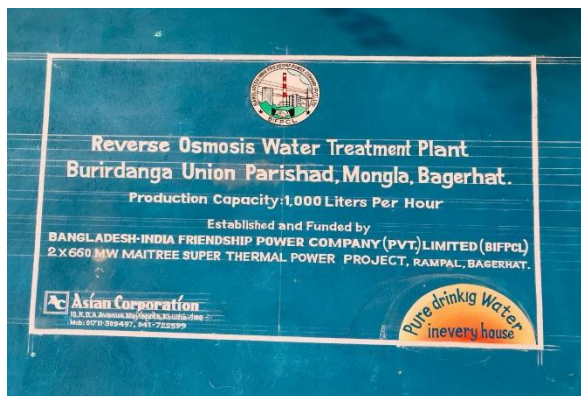


Emergency Medical Support Boat and Free medical Camp



School bag and Scientific Lab Development with the support of BIFPCL





RO WTP and Cloth distribution with the support of BIFPCL



Wheel Chai Distribution and Home Drinking water Filter distribution with the support of BIFPCL

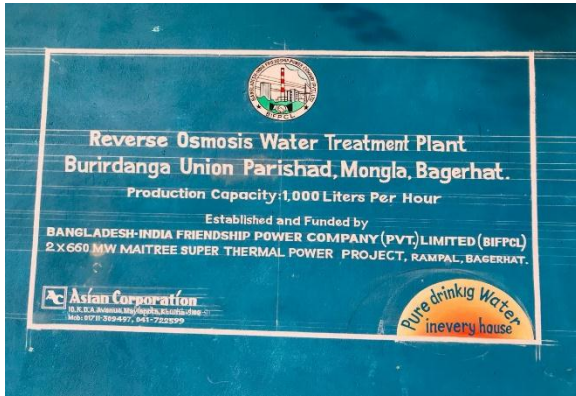


Emergency Medical Support Boat and Free medical Camp



School bag and Scientific Lab Development with the support of BIFPCL





RO WTP and Cloth distribution with the support of BIFPCL



Wheel Chair Distribution and Home Drinking water Filter distribution with the support of BIFPCL

**Figure 5.1: CSR Activities done by BIFPCL**



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## **Appendices**





## Appendix I: Checklist of Monitoring Environmental Compliances

**Table A: Checklist of Monitoring for ESMP Implementation (During Construction Phase)**

SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Generation of Noise within the BIFPCL's Plant premises	<ul style="list-style-type: none"> <li>• Conduct noise survey around and inside the site boundary</li> <li>• Reducing Noise and Vibrations to country's ambient standards, and occupational health and safety standards</li> <li>• Introducing vehicle speed limit and speed limit monitoring system</li> <li>• Green Plantation around the Project boundary</li> <li>• Switching off/ throttling down of machines/equipment's/generators which are not in use</li> </ul>			
2	Dust Generation from Land development activities and other construction works	<ul style="list-style-type: none"> <li>• Conducting dust monitoring and visual inspection around the site boundary</li> <li>• No use of earthen and undeveloped roads by vehicles related to the Project use</li> <li>• Installation of water spraying system to control fugitive dusts</li> <li>• Introducing vehicle speed limit and speed limit monitoring system</li> <li>• If yes, do they monitor vehicle speed regularly?</li> </ul>			
3	Water Quality	<ul style="list-style-type: none"> <li>• Fencing the construction site by drum sheet or Tarjja of any other fencing</li> <li>• Arrangement of runoff drainage for reducing any water logging</li> <li>• Location of backfilling stockpile in safe area and protected from wind and rain action</li> <li>• No storing of backfilling materials/spoil stored on river bank/slope</li> <li>• No disposal of waste and wastewater to river or canal.</li> </ul>			
4	Waste Management System	<ul style="list-style-type: none"> <li>• Provision of onsite waste management system</li> </ul>			
5	Compensation and Resettlement	<ul style="list-style-type: none"> <li>• Prepare Proper resettlement action plan and compensation plan if the Project needs any land acquisition addressing compensation, restoration, livelihood, living standards etc. based</li> </ul>			

SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		<ul style="list-style-type: none"> <li>on proper socio economic studies</li> <li>• Resettlement of the PAPs</li> <li>• cash for compensation of land (CCL) before resettlement</li> <li>• formal agreement with the affected people prior to migration/resettlement</li> <li>• Sufficient standing crop compensation</li> <li>• Compensation for shift able structures?</li> <li>• Retention of salvageable materials?</li> <li>• Compensation for loss of trading income?</li> <li>• one time moving assistance</li> <li>• grant to cover loss of regular wage income</li> <li>• Has a resettlement plan been developed which includes compensation, restoration, livelihood, living standards etc. based on proper socio economic studies?</li> <li>• Provide/take extra care/caution for the disadvantaged/vulnerable group(s) (i.e. women, children, ethnic minorities, indigenous people etc.)</li> <li>• Provision of monitoring the compensation and resettlement process</li> </ul>			
6	Livelihood and living	<ul style="list-style-type: none"> <li>• Does the Project pose any threat to the livelihood/living standards of the local people?</li> <li>• If yes, are adequate steps taken to reduce the impacts?</li> <li>• Has the company developed any policy which prioritizes the local labourers in employment opportunities?</li> <li>• Is there any possibility that large vehicle related to the Project will cause traffic induced disturbance/s to the local dwellers?</li> <li>• If yes, are there any mitigative steps taken to decrease the disturbance/s?</li> <li>• Has the road network been developed after the Project being proposed and during the construction phase?</li> <li>• Are there separate water and sanitation facilities for the</li> </ul>			

SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		construction workers in the Project area?			
7	Green House Gas Controlling Measures	<ul style="list-style-type: none"> <li>• Use of efficient generator in the construction activities</li> <li>• Regular maintenance of vehicles, generator and machinery in accordance with manufacturer's specifications</li> <li>• Use of approved pollution control devices fitted in the equipment's and machineries</li> <li>• Switching off and throttling down the machines/equipment's/generators which are not in use</li> </ul>			

**Table B: Checklist of Monitoring ESMP Implementation (During Construction phase)**  
**(Labor and Working Condition)**

**Basic Data**

SI No	Description	Values
1	Direct Workers	
2	Contracted Workers	
3	Supply Chain Workers	
4	Child labor	
5	0 - 12	
6	13 - 14	
7	14 - 18	

### Checklist for Labor and Working Condition

SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Working Conditions and Management of Worker Relationship	<ul style="list-style-type: none"> <li>• Preparation of Human Resources Policies and Procedures for Direct workers</li> <li>• Defined Working condition and Terms of Employment for direct worker</li> <li>• Sustainably equivalent terms and condition for migrant workers</li> <li>• Compliance to national law of forming workers' organization</li> <li>• No discrimination and equal opportunity for all</li> <li>• Measures for diminishing past discrimination</li> <li>• Grievance Mechanism</li> </ul>			
	Protecting Workforce	<ul style="list-style-type: none"> <li>• The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.</li> <li>• No Force Labor</li> </ul>			
2	Safety at site	<ul style="list-style-type: none"> <li>• Installation/Construction of Safety Fence around the Project area</li> <li>• Use of Personnel Protective Equipment (i.e. safety suit, safety goggles, ear plug, safety shoes, gloves, dust mask, etc.)</li> <li>• Safety trainings for workers (i.e. fire control, working at height, working in heat, first aid etc.)</li> <li>• Practice of Tool box meeting, safety talks,</li> <li>• Safe Storage of Hazardous Chemicals (e.g. fuel, flammable chemical, toxic chemicals, etc.)</li> <li>• Maintaining Material Safety Data Sheet (MSDS)</li> <li>• Provision of Health care facilities such as doctor, hospital etc available at/nearby the plant construction site</li> <li>• Availability of First Aid at work place</li> <li>• Preparation and Follow of Emergency Response Plan</li> <li>• Adequate fire precautions in place (for example, fire extinguishers,</li> </ul>			

SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		escape routes etc.) • Documentation and reporting of occupational accidents, diseases, and incidents • Policies and procedures for managing and monitoring the performance of third party employers in relation to OHS			
3	Occupational Health and Safety Procedure	• Provision of complete EHS division in the Human Resources Planning/Organogram • Preparation of Safety Policy to be adopted during plant operation			
4	Worker's Well Being	• Establishment Grievance Mechanisms • Ensuring fair treatment, non-discrimination and equal opportunity • Compliance of Project's labor policy with the national labor law • No Child Labor • No incident of forced labor • Provision of Welfare facilities for Worker/Labor			



**Table C: Checklist of Monitoring ESMP Implementation (During Construction phase)**  
**(Community Health, Safety and Security)**

SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Disturbance to nearby community due to dust from newly developed land and Noise from construction activities	<ul style="list-style-type: none"> <li>• Construction of boundary wall around the Project are</li> <li>• Installation of water spraying system to control dusts</li> <li>• Conducting dust monitoring and visual inspection around the site boundary</li> <li>• Adoption of Noise management plan</li> </ul>			
2	Grievance of local people	<ul style="list-style-type: none"> <li>• Availability and operation of Grievance Redress Mechanism</li> <li>• Maintaining open communication channel with the local community</li> </ul>			
3	Risk of breaching Community Safety	<ul style="list-style-type: none"> <li>• Construction of boundary wall/safety fence around the Project area</li> <li>• Practicing Risk Assessment and Evaluation Process</li> <li>• Practicing safe management for hazardous materials which may pose threat to the community</li> <li>• Availability and operation of Emergency Response Plan</li> <li>• Maintaining open communication channel with the local community</li> <li>• Training and instruction to the security personnel about their behaviour and communication with the local people</li> <li>• Aware the security personnel about the right of the community people</li> </ul>			
4	Community Health Risk	<ul style="list-style-type: none"> <li>• Provision of providing health service facilities to community if the Project possess any health risk like sexually transmitted disease, communicable disease, vector-borne diseases</li> <li>• Implement all pollution mitigation measures to ensure safeguarding to community</li> </ul>			<b>(Continued)</b>

SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
5	Youth Employment	<ul style="list-style-type: none"> <li>Providing training/awareness program for the local youth to let them aware about the required ualification to get involved in the Project related activities</li> </ul>			
6	Public Communication, Consultation and Awareness	<ul style="list-style-type: none"> <li>Arranging public communication/consultation meeting</li> <li>Sharing of Project information with local people</li> <li>Organizing environmental and social awareness programs/meetings</li> </ul>			

**Table D: Checklist of Monitoring ESMP Implementation (During Construction phase)  
(Biodiversity and Sustainable Management of Living Natural Resources)**

SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
1	Runoff (contain mostly sediment load) from newly developed land falls into nearby river and channel.	<ul style="list-style-type: none"> <li>Installation of proper run on/runoff drains</li> <li>Use of sediment fences, traps and basins for trapping the sediment, if required</li> </ul>			
2	Disturbance to nearby ecosystem due to different construction activities	<ul style="list-style-type: none"> <li>No cutting/ felling of trees along the river bank</li> <li>Implementation of on-site waste and air quality management plan</li> <li>Limiting soil extraction activities limited within the defined area</li> <li>Limiting the vegetation clearance and base stripping process within the Project boundary</li> <li>Safety fence around the construction site</li> <li>Limiting the use of night light</li> <li>Using shade (directed downwards) around the outdoor lights</li> <li>Provision of cut-off time to switch off unnecessary lights at night</li> <li>Initiate Green plantation</li> </ul>			

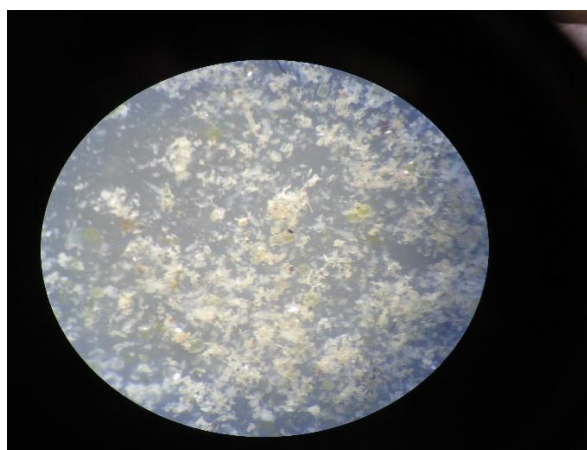
SI No	Potential Impacts	Proposed EMP	Actual Implementation	Recommended Action	Compliance Status
		<ul style="list-style-type: none"> <li>• No plantation of non-native species</li> <li>• Retaining top soil for future habitat restoration</li> <li>• No degradation of critical habitat?</li> </ul>			
3	Occupation of river, inter-tidal areas and wetlands	<ul style="list-style-type: none"> <li>• No encroachment of inter-tidal flood plain area</li> <li>• No disturbance to Dolphin community</li> <li>• Monitoring of Ecosystem Health and Monitoring of Sundarbans Forest Health</li> <li>• If required, embankment should be constructed considering a setback distance from river/canal bank</li> <li>• Slope protection work along the Maidara River should be completed on an urgent basis before rainy season come and</li> <li>• BIFPCL may take initiatives of excavating of silted reach of Maidara river near proposed township area to facilitate proper functioning of River for maintaining tidal dynamics</li> </ul>			

## Appendix II: Photo Album

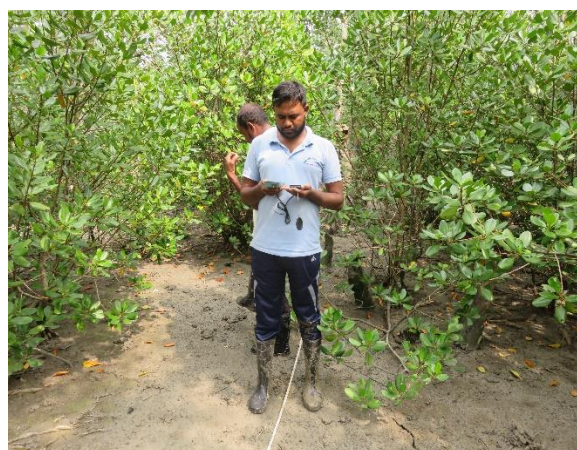
### Environmental and Socio-economic Monitoring of Khulna 2×660 MW Power Plant for 22<sup>nd</sup> monitoring program (November, 2019)



Monitoring team



Microscopic view of benthos community



Measuring the light intensity





Measuring tree height



Counting crab hole and pneumatophore



Measuring canopy cover



Data acquisition for forest health



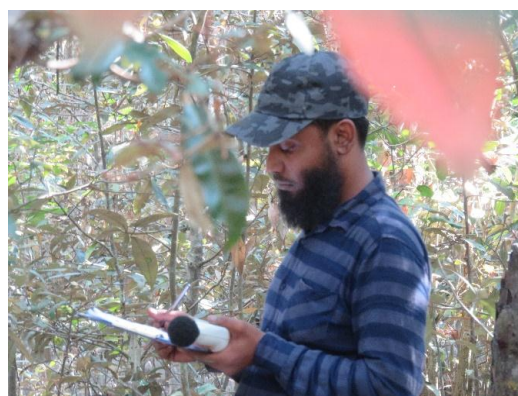
Surveying Fishermen



Collection of plankton samples



Data collection of in-situ water quality parameters



Monitoring of noise level




## Appendix III: Terms of References (ToR)

### Background

Bangladesh-India friendship Power Company (Pvt.) Ltd. (BIFPCL), a 50:50 Joint Venture Company of Bangladesh Power Development Board (BPDB) of Bangladesh & NTPC Limited of India is implementing a coal based thermal power plant named 2X660 MW Maitree Super Thermal Power Project at Rampal in Bagerghat district of Khulna division of Bangladesh. The plant is envisaged to be based on super critical technology and is to be operated as Base Load Plant. The fuel envisaged is imported coal.

### General Description of 2X660 MW Maitree Super Thermal Power Plant Project

<b>Project Location:</b>	<p>Upazila: Rampal, District: Bagerghat          Site is located at 23 kms Southward of Khulna City and 14 kms. North-Eastward from Mongla Port.</p> 
<b>Project Capacity:</b>	1320 MW (2x660 MW), based on Ultra Super-critical Technology
<b>Mode of Operation:</b>	Base Load
<b>Fuel:</b>	Imported Coal
<b>Fuel Transportation:</b>	It is envisaged that imported coal from countries like Indonesia, Australia shall be transported through bigger ships, up to trans-shipment point, from where the coal shall be transported through barges to the coal unloading jetty at the plant end. From jetty to the power plant coal shall be transported through coal conveyor system.
<b>Land &amp; Land</b>	Based on the layout in the FR, it is estimated that approx. 575 acres of land

<b>Development:</b>	will be required for the project. (375 Acres for Main Plant, 50 Acres for Township, 50 Acres for Jetty).
<b>Evacuation of power:</b>	Provision of line bays in generation switchyard for one no. 400 kV Double Circuit line and one no. 230 kV Double Circuit line have been kept. The Power evacuation (transmission line) system from the Project shall be at 400 kV level and will be outside the scope of the Project. 400 kV is being introduced for the first time in Bangladesh.
<b>Expected Timeline for project implementation</b>	The first unit of capacity 660 MW is scheduled to be synchronised in 41 months from the date of NTP to the EPC contractor for the Power project. Commissioning of the first unit of capacity 660 MW is envisaged at an interval of 5 months thereafter.

### **Broad Scope of Works**

The study covers quarterly monitoring of different environmental and social parameters, and implementation of EMP (Environment Management Plan) during implementation phases as per DoE approval/requirement. The monitoring locations were selected based on physical activities, wind direction, sensitive receptors, etc. and were finalized through the consultation with DoE, Department of Fisheries (DoF), MPA and Forest Department (FD).

### **The Broad objectives of independent monitoring covers the following activities**

- Monitoring implementation of EMP and environmental compliance;
- Monitoring of ambient air quality, noise level and water quality;
- Monitoring of cropping pattern and soil quality;
- Monitoring of fisheries resources covering fish habitats, biodiversity, migration and production;
- Monitoring of ecosystem and biodiversity;
- Monitoring of the Sundarbans Forest Health; and
- Monitoring of socio-economic condition and livelihoods.
- To evaluate the project environmental performance as due to construction activities.

### **The main objectives of this works are**

- Monitoring of Social and Environmental parameters to update the baseline.
- Monitoring of Social and Environmental parameters during Implementation of the Project.
- Assistance to BIFPCL for implementation of Environmental Management Plan (EMP) during construction period.

**The scope of work of the Independent Monitoring will include the following specific tasks**

- Develop specific monitoring indicators, checklists, and questionnaires to undertake independent monitoring (a preliminary list of monitoring indicators has been given in the EMP) in consultation with BIFPCL, DoE, Forest Department and the Financer;
- Review and verify the implementation progress of various EMP elements, particularly, mitigation plan, compliance monitoring, environmental trainings, documentation, and grievance redress mechanism;
- Physical aspects would cover air quality, noise level, water quality and land resources;
- Biological environment includes fisheries resources, ecological resources, Sundarbans Reserve Forest (SRF) health conditions including WHS;
- Environmental compliance monitoring includes Monitoring of Environmental and Social Management System Action Plan Implementation, Monitoring of labour and working conditions, Monitoring of community health, safety and security and monitoring of biodiversity and sustainable management of living natural resources.
- To establish baseline environmental conditions;
- Provide and monitor the environmental parameter during construction activities.
- To detect adverse environmental impacts for river dredging and other activities of site development;
- Provide technical assistance to the client for implementation of the EMP during the power plant construction at different sector of construction activities.
- To demonstrate whether the environmental control measures are operating as per designed;
- To provide data for emission inventories;
- To provide data at regular intervals for dissemination to the stakeholders
- To provide data for improvement and updating of the monitoring program;
- To assist in investigating the event of a trigger level or emission limit value being crossed.
- Update baseline data as per monitoring schedule and location.
- Provide technical assistance to the client for implementation of the EMP during power plant construction.
- Review the EIA document to evaluate the EMP measures incorporated in the contract to mitigate different social and environmental hazards and risks during construction of the Project
- Submit progress reports to the client.

- Physical observation to assess that all mitigation measures mentioned in EMP are carried out in all place.
- Sampling and carrying out necessary analysis of Environmental parameter such as surface & ground water quality, air quality, noise, Biological Environment, Socio-economic environment, Sundarban Forest health etc. according to the monitoring framework in construction phase.
- Morphological changes of the adjacent river of the project will be influenced by the constructional activities. River bank erosion-accretion, drainage system, tidal inundation etc. will be investigate after regular intervals in the study area as per monitoring location of the EIA. The procedure of investigation and methodologies of analysis will be the same as pre-construction phases. River bed pollution will be identified though this study during construction of the power plant.
- Monitoring of floral resources will be performed quarterly. The indicators and procedures of flora monitoring will be relatively same as earlier studies of this projects. Plant composition, canopy coverage, indigenous and exotic species, plant intensities will be the main monitoring indicators during construction phases.
- Monitoring of faunal resources will be performed quarterly at the construction period. Faunal resources survey will coincide with floral resources survey as it will provided more insight about the inter-dependency between flora and fauna in an ecosystem.
- Render any other related services as and when requested.
- Conduct community level consultation in a regular interval and disclose project level information.
- Keep liaison with different organization like Govt department, NGOs, and relevant stakeholders.

**The Monitoring parameter & associated indicator are given below**

Monitoring Parameter	Indicators
Socio-economy	Livelihood and Occupation
	Income and expenditure
	Displacement and Migration
	Cultural and heritage
	Health and sanitation
	Risks and accidental assessment
	Transportation and communication
	Public and private Infrastructure development
Ecology and Biodiversity	Bio-indicator Assessment
	Movement of indigenous/ native species
	Envision of exotic species and regime dominance
	Species composition (Flora and Fauna)
	Assessment the services of dependent ecosystem
Agriculture	Land use and canopy coverage

Monitoring Parameter	Indicators
	Soil quality (Salinity, pH, OM,)
	Cropping pattern and crop intensities
	Irrigation and crop production
	Farmers survey result
Fisheries	Fish diversity and specification
	Fish production and availability
	Fisher survey result
Noise level	Sound level at the sensitive zone
Water resources	DO, BOD, COD, Salinity, TDS, TS, pH, Hg, Pb
	Total Hardness, Hg, NO <sub>3</sub> and PO <sub>4</sub>
	River Morphology,
	Tidal inundation
	Drainage Network
	Erosion and Accretion
	Ground water quality
Air quality	SO <sub>x</sub>
	NO <sub>x</sub>
	SPM (PM <sub>10</sub> and PM <sub>2.5</sub> )
	CO

### Air quality monitoring progress

The most commonly used method for automatically monitoring air pollutant such as those above are:

- SO<sub>x</sub>: measured by Fluorescent signal generated by exciting SO<sub>2</sub> with UV light
- NO<sub>x</sub>: measured by Chemiluminescent reaction between NO<sub>x</sub> & O<sub>3</sub>
- O<sub>3</sub>: measured by ultra violet absorption analyzer, this determines the Ozone concentration by the attenuation of 254 nm UV light along this signal fixed path cell
- Particulate matter (SPM, PM<sub>10</sub>, PM<sub>2.5</sub>): measured by gravimetric methods including true micro weighing technology for automatic monitoring & instrument named 'Tapered element oscillating micro balance (TOEM)' has been most frequently used. Measurement on filter tape using the principles of beta attenuation for estimating 30 min or 1 hr average concentrations of PM<sub>10</sub> or PM<sub>2.5</sub> has also been used.
- CO: In urban air pollution studies, a non-disruptive infrared photo meter utilizing a gas filter co relation technology & state of the art optical & electronic technology is used to measure low concentration of CO accurately & reliably.

### Expected Output

A breach of a trigger level or emission limit values may indicate a significant increase of a contaminate concentration in an environmental medium.

Baseline Monitoring is monitoring in and around the location of a proposed site so as to establish background environmental conditions prior to any development of the proposed site. In case of existing facilities, baseline-monitoring serves as a reference point to which



later monitoring results are compared. The information will be used to evaluate in future compliance monitoring.

Compliance monitoring is periodic monitoring and is to determine whether there is any release of contaminants to the environment and to demonstrate compliance within the project area. It includes measurements of process conditions, process emissions and levels in receiving environments and the reporting of the results of such measurements to demonstrate compliance with limits specified in the legislation.

The information provided by compliance monitoring is also valuable for other environmental and management activities (e.g. for optimizing process, protecting sensitive ecosystems and informing the public of the effectiveness of environmental protection measures).

Assessment monitoring is investigative monitoring which is initiated after detection of the impacts to the environment or on attaining a trigger level. The assessment monitoring will:

- Identify the source of release materials;
- Characterize the nature, extent and rate of releases;
- Evaluate the risk to the environment and to human health;
- Evaluate measures to prevent or minimize future releases;
- Provide information for the design and implementation of corrective measures and
- Express the residual environmental impacts for proper compensation.

### Reporting Requirements

As it is proposed to carry out the monitoring program for two quarters and the proposed deliverables are scheduled below

SL	Name	no. of copies
1	Monitoring Report after each monitoring mission (each in one quarter) with complete data, analysis, lab. Results, discussion etc as intended in the scope of work.	10
2	CD-ROM in respect of documents/datasheets	1

## Appendix IV: Monitoring Data

### (A) Air Quality Data

Table A1: Ambient Air Quality Monitoring Results

Locations of Monitoring	Pollutants	1 <sup>st</sup> QM, Apr 2014	2 <sup>nd</sup> QM, Jul 2014	3 <sup>rd</sup> QM, Oct 2014	4 <sup>th</sup> QM, Jan 2015	5 <sup>th</sup> QM, Apr 2015	6 <sup>th</sup> QM, Jul 2015	7 <sup>th</sup> QM, Oct 2015	8 <sup>th</sup> QM, Jan 2016	9 <sup>th</sup> QM, Apr 2016	10 <sup>th</sup> QM, Jul 2016	11 <sup>th</sup> QM, Oct 2016	12 <sup>th</sup> QM, Jan 2017	13 <sup>th</sup> QM, April, 2017	14 <sup>th</sup> QM, Oct, 2017	15 <sup>th</sup> QM Jan, 2018	16 <sup>th</sup> QM April, 2018	17 <sup>th</sup> QM, Jul 2018	18 <sup>th</sup> QM, Nov, 2018	19 <sup>th</sup> QM, Feb, 2019	20 <sup>th</sup> QM, Apr, 2019	21 <sup>st</sup> QM, Jul, 2019	21 <sup>st</sup> QM, Jul, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	
Concentrations are in µg/m3																								
SW Corner of the PP area	PM <sub>2.5</sub>	33	37	25	33	47	25	22	34	19	5	9	24.8	8.12	28.2	32.9	28.4	15.2	31.1	27.3	21.7	37.76	51.32	65 <sup>24hr</sup>
	PM <sub>10</sub>	78	77	53	79	83	35	52	135	117	32	22	79	43.8	73.6	133	70	15.8	106	105.4	98.2	67.15	127.65	150 <sup>24hr</sup>
	SPM	207	239	190	200	177	42	91	175	332	51	53	115.7	122.4	169.4	145.6	121.5	12.9	137.4	151.6	128.6	109.25	183.56	200 <sup>8hr</sup>
	SO <sub>2</sub>	21	24	19	23	15	52	35	14	18	9	8	9.5	9.0	7.2	14.3	11.4	11.9	12.7	11.6	13.9	56.5	31.53	365 <sup>24hr</sup>
	NO <sub>x</sub>	26	29	27	31	29	35	29	18	18	12	10	11.3	10.7	7.5	17.7	12.8	10.2	14.8	12.4	16	55.08	24.97	100 <sup>Annual</sup>
	CO	120	188	140	190	144	146	88	74	57	35	119	59	91	73	61	32	11.1	28	15	18	4	16	(10000) <sup>8hr</sup>
	O <sub>3</sub>	27	26	19	22	26	12	5	4	1	1	1	5	03	10	03	9	13.2	7	9	6	25	10	157 <sup>8hr</sup>
Shapmari area	PM <sub>2.5</sub>	39	48	48	39	34	18	17	35	25	3	8	25	14.6	8.5	31.5	26.7	15.8	35.7	30.6	18.9	50.24	19.34	65 <sup>24hr</sup>

Locations of Monitoring	Pollutants	1 <sup>st</sup> QM, Apr 2014	2 <sup>nd</sup> QM, Jul 2014	3 <sup>rd</sup> QM, Oct 2014	4 <sup>th</sup> QM, Jan 2015	5 <sup>th</sup> QM, Apr 2015	6 <sup>th</sup> QM, Jul2015	7 <sup>th</sup> QM, Oct 2015	8 <sup>th</sup> QM, Jan 2016	9 <sup>th</sup> QM, Apr 2016	10 <sup>th</sup> QM, Jul 2016	11 <sup>th</sup> QM, Oct 2016	12 <sup>th</sup> QM, Jan 2017	13 <sup>th</sup> QM, April, 2017	14 <sup>th</sup> QM, Oct, 2017	15 <sup>th</sup> QM Jan, 2018	16 <sup>th</sup> QM April, 2018	17 <sup>th</sup> QM, Jul 2018	18 <sup>th</sup> QM, Nov, 2018	19 <sup>th</sup> QM, Feb, 2019	20 <sup>th</sup> QM, Apr, 2019	21 <sup>st</sup> QM, Jul, 2019	21 <sup>st</sup> QM, Jul, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	
		Concentrations are in µg/m3																						
	PM <sub>10</sub>	814.69	90	74	102	97	31	48	116	44	11	11	99.5	56.9	40.4	147.8	52	64.4	109.9	126.3	106.1	63.94	82.27	150 <sup>24hr</sup>
	SPM	2156.3	263	217	274	266	47	79	192	187	27	23	154.2	136.7	45.3	181.4	138.7	113.4	143.9	168	150.8	123.56	120.45	200 <sup>8hr</sup>
	SO <sub>2</sub>	19	28	22	21	22	58	27	13	11	4	6	12.9	10	4.3	15	9.6	10.8	12.2	12.3	12.1	31.53	60.26	365 <sup>24hr</sup>
	NOx	29	39	27	26	24	46	25	16	22	6	8	15.7	11.8	6	18.6	10.2	13.1	13.6	13.8	13.9	24.97	58.39	100 <sup>Annual</sup>
	CO	165	210	230	164	136	127	102	77	22	31	108	66	78	79	69	27	25	30	21	20	4	11	(10000) <sup>8hr</sup>
	O <sub>3</sub>	33	26	26	23	21	16	1	1	1	0	0	1	08	25	04	4	8	6	4	1	34	22	157 <sup>8hr</sup>
NW Corner of the PP area	PM <sub>2.5</sub>	37	44	19	42	59	28	19	24	11	3	10	29	10.3	15.2	40.7	27.7	12.9	32.3	20.3	14.2	37.27	33.2	65 <sup>24hr</sup>
	PM <sub>10</sub>	67	78	56	98	91	96	29	125	29	24	14	108.7	31.3	49.9	136.3	100.1	44.3	117.4	93.6	58.7	42.99	1119.34	150 <sup>24hr</sup>
	SPM	234	217	157	310	244	321	66	187	115	31	35	168	91.7	63.9	161.7	116.2	76.3	156.2	125.5	119.2	60.45	175.13	200 <sup>8hr</sup>
	SO <sub>2</sub>	19	22	18	27	21	56	32	13	17	4	8	12.2	5.8	7.5	9.6	13.2	5.8	13.4	10.7	11.6	60.26	54.02	365 <sup>24hr</sup>
	NOx	23	28	22	32	39	43	21	18	16	5	11	14.7	7.1	9.2	11.7	14.3	5.9	15	11.3	13.5	58.39	43.45	100 <sup>Annual</sup>
	CO	110	178	110	210	140	133	87	77	38	47	127	31	74	80	45	43	21	32	20	16	7	0	(10000) <sup>8hr</sup>
Barni, Gaurambha	O <sub>3</sub>	25	19	17	36	44	11	8	2	0	1	1	3	05	10	05	7	6	8	1	5	18	2	157 <sup>8hr</sup>
	PM <sub>2.5</sub>	39	47	57	39	41	34	11	29	23	9	10	21.7	7.9	13.8	52.3	18	11.9	15.4	19.3	19.7	57.51	31.28	65 <sup>24hr</sup>
	PM <sub>10</sub>	103	122	67	97	82	65	26	97	82	45	13	105.4	30.5	30.2	140	30.5	20.5	50.1	102	69.9	33.25	69.32	150 <sup>24hr</sup>
	SPM	233	244	183	277	236	79	112	176	268	69	30	167.8	95.6	57.2	171.9	90.6	5.2	113.5	127.5	92.2	75.13	102.17	200 <sup>8hr</sup>
	SO <sub>2</sub>	21	23	17	22	25	41	31	16	20	10	7	12.2	5.5	4.1	13.8	6.1	6.1	9.5	11.5	12.6	54.02	59.33	365 <sup>24hr</sup>
	NOx	25	28	22	26	27	44	32	21	16	12	9	19.3	9.8	5.0	16.7	7.3	7.4	10.7	13.8	13.8	43.45	57.02	100 <sup>Annual</sup>
Chunkuri-2, Bajua	CO	175	210	190	150	196	96	96	81	73	41	98	63	85	77	59	24	20	20	17	18	6	0	(10000) <sup>8hr</sup>
	O <sub>3</sub>	26	29	22	19	15	9	6	4	0	0	3	5	08	6	04	6	6	2	3	4	7	52	157 <sup>8hr</sup>
	PM <sub>2.5</sub>	35	39	46	37	33	35	28	31	25	7	5	25.2	8.7	17.3	33.4	11.4	10.2	26.8	22.8	15	19.46	33.74	65 <sup>24hr</sup>

Locations of Monitoring	Pollutants	1 <sup>st</sup> QM, Apr 2014	2 <sup>nd</sup> QM, Jul 2014	3 <sup>rd</sup> QM, Oct 2014	4 <sup>th</sup> QM, Jan 2015	5 <sup>th</sup> QM, Apr 2015	6 <sup>th</sup> QM, Jul2015	7 <sup>th</sup> QM, Oct 2015	8 <sup>th</sup> QM, Jan 2016	9 <sup>th</sup> QM, Apr 2016	10 <sup>th</sup> QM, Jul 2016	11 <sup>th</sup> QM, Oct 2016	12 <sup>th</sup> QM, Jan 2017	13 <sup>th</sup> QM, April, 2017	14 <sup>th</sup> QM, Oct, 2017	15 <sup>th</sup> QM Jan, 2018	16 <sup>th</sup> QM April, 2018	17 <sup>th</sup> QM, Jul 2018	18 <sup>th</sup> QM, Nov, 2018	19 <sup>th</sup> QM, Feb, 2019	20 <sup>th</sup> QM, Apr, 2019	21 <sup>st</sup> QM, Jul, 2019	21 <sup>st</sup> QM, Jul, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	
Concentrations are in µg/m3																								
	PM <sub>10</sub>	77	86	69	68	61	109	49	98	60	23	20	74.4	44.4	100.2	157.1	40.6	30.6	105.9	126.7	72.7	46.37	78.27	150 <sup>24hr</sup>
	SPM	117	113	162	183	188	175	94	167	167	31	48	162	110.6	127.8	200	108	78.6	128.5	146.6	117.6	80.31	100.95	200 <sup>8hr</sup>
	SO <sub>2</sub>	19	24	21	18	11	55	33	21	13	7	9	18.9	8.2	7.9	19	10.4	7.5	12.1	12.4	11.2	45.81	35.42	365 <sup>24hr</sup>
	NOx	23	26	27	24	18	49	23	16	25	10	8	18	11.2	8.4	20.7	11.6	8.4	14	13.8	13.7	44.92	40.09	100 <sup>Annual</sup>
	CO	190	205	170	170	33	133	75	70	33	38	79	36	94	69	58	42	23	27	25	20	10	0	(10000) <sup>8hr</sup>
	O <sub>3</sub>	27	24	18	22	41	21	2	1	1	0	2	2	03	5	05	2	4	5	9	8	2	38	157 <sup>8hr</sup>
Pankhali, Dacope	PM <sub>2.5</sub>	47	49	57	41	39	34	25	47	15	8	10	38.7	15.8	17	72.3	15.9	11.1	24.8	28.6	15.8	24.03	24.03	65 <sup>24hr</sup>
	PM <sub>10</sub>	119	127	139	101	105	144	62	128	46	42	18	141.6	105	63.4	208.9	74.3	58.4	92	125.8	92.7	56.56	119.28	150 <sup>24hr</sup>
	SPM	297	266	254	208	299	339	183	198	114	78	34	194.6	179	87.5	223.9	154.1	98.4	139	178.2	141.1	93.5	100.95	200 <sup>8hr</sup>
	SO <sub>2</sub>	28	31	31	24	30	58	36	18	9	8	8	16.1	12.9	8	16.3	12.2	9.4	10.4	13.3	10.4	59.41	44.29	365 <sup>24hr</sup>
	NOx	41	39	36	26	27	47	23	15	19	9	9	19	18.7	10.2	17.7	13.7	12.1	13.4	14.9	11.7	51.09	17.72	100 <sup>Annual</sup>
	CO	230	217	250	188	177	125	105	101	55	29	112	48	83	87	49	34	29	30	14	14	9	0	(10000) <sup>8hr</sup>
O <sub>3</sub>	49	38	36	27	11	13	5	2	2	0	0	3	06	0	06	6	8	8	8	3	22	26	157 <sup>8hr</sup>	
Mongla Port area	PM <sub>2.5</sub>	47	55	39	41	26	33	19	34	21	9	11	25.7	22.6	33.2	70.1	23.2	13.2	30.3	26.6	35	56.67	39.69	65 <sup>24hr</sup>
	PM <sub>10</sub>	139	174	77	82	35	52	33	132	45	29	15	119.3	93.6	97	209.1	89.9	47.5	103.7	109.3	131	119	64.12	150 <sup>24hr</sup>
	SPM	288	303	197	217	214	118	65	189	144	50	6	172.3	196	187.2	242	144.7	73.7	161.9	157.1	183.1	192.17	83.9	200 <sup>8hr</sup>
	SO <sub>2</sub>	27	28	26	24	14	45	36	16	10	8	7	16.8	10.5	8.2	15.5	11.8	6.5	12	10.8	16.8	59.33	57.24	365 <sup>24hr</sup>
	NOx	44	39	33	27	17	40	20	13	14	10	8	15.3	15.1	10.7	18.4	13.2	7.2	16.8	12.6	17.8	57.02	46.58	100 <sup>Annual</sup>
	CO	230	320	220	211	24	110	84	71	29	31	97	44	72	79	52	29	20	33	28	17	15	48	(10000) <sup>8hr</sup>
O <sub>3</sub>	57	52	37	26	09	15	8	3	1	2	1	4	04	9	02	3	1	9	7	3	5	40	157 <sup>8hr</sup>	
Harbaria, Sundarbans	PM <sub>2.5</sub>	19	22	33	27	24	27	24	26	13	6	10	19.2	10.5	28.3	43.5	11.6	11.4	20.6	15.4	14.2	28.03	39.69	65 <sup>24hr</sup>

Locations of Monitoring	Pollutants	1 <sup>st</sup> QM, Apr 2014	2 <sup>nd</sup> QM, Jul 2014	3 <sup>rd</sup> QM, Oct 2014	4 <sup>th</sup> QM, Jan 2015	5 <sup>th</sup> QM, Apr 2015	6 <sup>th</sup> QM, Jul2015	7 <sup>th</sup> QM, Oct 2015	8 <sup>th</sup> QM, Jan 2016	9 <sup>th</sup> QM, Apr 2016	10 <sup>th</sup> QM, Jul 2016	11 <sup>th</sup> QM, Oct 2016	12 <sup>th</sup> QM, Jan 2017	13 <sup>th</sup> QM, April, 2017	14 <sup>th</sup> QM, Oct, 2017	15 <sup>th</sup> QM Jan, 2018	16 <sup>th</sup> QM April, 2018	17 <sup>th</sup> QM, Jul 2018	18 <sup>th</sup> QM, Nov, 2018	19 <sup>th</sup> QM, Feb, 2019	20 <sup>th</sup> QM, Apr, 2019	21 <sup>st</sup> QM, Jul, 2019	21 <sup>st</sup> QM, Jul, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	
Concentrations are in µg/m3																								
	PM <sub>10</sub>	41	39	59	56	49	42	50	82	42	20	14	85.2	36.7	89.9	152.4	29.1	24.3	80.5	92.6	63.9	21.85	64.12	150 <sup>24hr</sup>
	SPM	111	117	129	139	109	70	73	159	91	43	44	93.5	103.7	107	189.9	72.4	47.6	90.3	118.3	90.9	48.09	83.9	200 <sup>8hr</sup>
	SO <sub>2</sub>	9	10	14	12	16	51	34	15	11	6	7	11.9	5.7	7.6	13.2	7.9	4.9	11.6	9.5	11.6	49.72	57.24	365 <sup>24hr</sup>
	NOx	19	22	27	18	22	34	22	14	16	8	10	13	7.7	9.3	15.2	8.3	5.4	13	10.1	13	41.91	46.58	100 <sup>Annual</sup>
	CO	65	58	70	64	56	112	81	62	47	32	110	67	73	84	57	31	20	20	25	16	16	48	(10000) <sup>8hr</sup>
	O <sub>3</sub>	13	12	13	11	14	12	4	2	2	0	1	4	08	0	02	2	6	4	3	5	8	40	157 <sup>8hr</sup>
Akram Point, Sundarbans	PM <sub>2.5</sub>	17	19	23	18	49	NO	25	18	9	4	4	14.3	13.2	7.5	35.4	13.7	14	29.1	16.2	13	19.68	36.67	65 <sup>24hr</sup>
	PM <sub>10</sub>	39	44	32	39	77	NO	32	77	31	15	14	85.5	96.0	37.8	150.6	36.4	41.6	100.2	93.2	51.9	43	87.15	150 <sup>24hr</sup>
	SPM	114	133	97	88	102	NO	51	128	46	23	27	90.9	137.0	41.8	175.1	90.3	58	121.4	117.8	71.1	83.9	122.62	200 <sup>8hr</sup>
	SO <sub>2</sub>	7	9	12	13	21	NO	27	14	9	4	6	8.4	6	5.8	14	8.3	6.3	10.8	10.1	8.9	57.24	35.23	365 <sup>24hr</sup>
	NOx	17	19	22	17	27	NO	19	15	10	5	6	12.7	10.1	5.9	15.1	9.9	9.3	11.7	11.3	9.4	46.58	31.26	100 <sup>Annual</sup>
	CO	49	60	50	46	163	NO	92	64	21	37	101	58	79	69	52	21	25	28	17	14	38	24	(10000) <sup>8hr</sup>
Hiron Point, Sundarbans	O <sub>3</sub>	11	14	9	10	27	NO	8	1	0	0	2	3	0	0	03	3	4	5	3	1	9	90	157 <sup>8hr</sup>
	PM <sub>2.5</sub>	15	23	19	17	28	NO	27	NO	17	NO	9	21.7	No	17.0	40.5	NO	NO	23.4	18.2	NO	NO	27.76	65 <sup>24hr</sup>
	PM <sub>10</sub>	44	38	34	41	60	NO	45	NO	40	NO	14	104.5	NO	92.1	149.8	NO	NO	86.7	96.1	NO	NO	67.89	150 <sup>24hr</sup>
	SPM	101	119	107	97	110	NO	88	NO	132	NO	26	111.4	NO	102	173.7	NO	NO	107.9	127.8	NO	NO	90.31	200 <sup>8hr</sup>
	SO <sub>2</sub>	8	7	13	14	15	NO	28	NO	15	NO	9	13.5	NO	6	15.8	NO	NO	10.6	10.7	NO	NO	45.81	365 <sup>24hr</sup>
	NOx	18	18	19	22	20	NO	23	NO	19	NO	9	15.9	NO	7.8	18.1	NO	NO	12.5	10.9	NO	NO	44.92	100 <sup>Annual</sup>
	CO	52	62	65	60	60	NO	93	NO	40	NO	121	43	NO	72	71	NO	NO	22	21	NO	NO	2	(10000) <sup>8hr</sup>
	O <sub>3</sub>	14	13	11	9	23	NO	2	NO	0	NO	0	4	NO	0	04	NO	NO	6	6	NO	NO	16	157 <sup>8hr</sup>
	PM <sub>2.5</sub>	54	39	52	42	55	46	19	35	11	16	9	34.6	23.1	19.5	78.7	12.4	12.5	21.3	20.8	33	38.59	18.65	65 <sup>24hr</sup>



Locations of Monitoring	Pollutants	1 <sup>st</sup> QM, Apr 2014	2 <sup>nd</sup> QM, Jul 2014	3 <sup>rd</sup> QM, Oct 2014	4 <sup>th</sup> QM, Jan 2015	5 <sup>th</sup> QM, Apr 2015	6 <sup>th</sup> QM, Jul 2015	7 <sup>th</sup> QM, Oct 2015	8 <sup>th</sup> QM, Jan 2016	9 <sup>th</sup> QM, Apr 2016	10 <sup>th</sup> QM, Jul 2016	11 <sup>th</sup> QM, Oct 2016	12 <sup>th</sup> QM, Jan 2017	13 <sup>th</sup> QM, April, 2017	14 <sup>th</sup> QM, Oct, 2017	15 <sup>th</sup> QM Jan, 2018	16 <sup>th</sup> QM April, 2018	17 <sup>th</sup> QM, Jul 2018	18 <sup>th</sup> QM, Nov, 2018	19 <sup>th</sup> QM, Feb, 2019	20 <sup>th</sup> QM, Apr, 2019	21 <sup>st</sup> QM, Jul, 2019	21 <sup>st</sup> QM, Jul, 2019	Bangladesh (DoE) Standard (ECR 2005)
Weather		Sunny	Rainy/ Cloudy	Sunny	Sunny	Sunny	Rainy/ Cloudy	Sunny/ Rainy	Sunny	Sunny	Rainy/ Cloudy	Rainy/ Cloudy	Sunny	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Rainy/ Cloudy	Sunny/ Cloudy	Sunny	Sunny	Sunny/ Cloudy	Sunny/ Cloudy	
Concentrations are in µg/m <sup>3</sup>																								
	PM <sub>10</sub>	139	117	91	84	75	89	49	112	69	68	24	145.9	99.5	39.6	213.9	38.8	45.4	57.9	91.3	125.9	47.05	59.19	150 <sup>24hr</sup>
	SPM	301	287	239	219	222	181	101	181	112	107	64	189.7	187.2	127.9	243.4	78.9	69.9	102.9	158	173.4	100.95	78.09	200 <sup>8hr</sup>
	SO <sub>2</sub>	33	29	33	28	31	59	28	16	11	10	10	17.1	7.2	7.1	21	7.5	7.5	8.7	10.4	15.3	35.42	49.72	365 <sup>24hr</sup>
	NO <sub>x</sub>	49	41	39	36	33	38	26	16	15	15	14	18.6	11.7	8.8	25	8.4	11.1	9.7	11.1	17.1	40.09	41.91	100 <sup>Annual</sup>
	CO	330	370	330	296	101	89	94	98	68	36	104	66	79	81	69	36	28	121	19	23	11	24	(10000) <sup>8hr</sup>
	O <sub>3</sub>	59	67	57	39	21	7	4	2	1	0	2	3	07	07	09	9	7	4	5	6	6	18	157 <sup>8hr</sup>
Township area	PM <sub>2.5</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	29.1	13.7	28.6	21.2	17.2	21.24	29.64	65 <sup>24hr</sup>
	PM <sub>10</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	70.3	60.8	111.7	88.7	61.6	96.71	98.15	150 <sup>24hr</sup>
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	120.6	98.1	144.6	129.4	102.5	127.79	127.79	200 <sup>8hr</sup>
	SO <sub>2</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	13.1	8.4	10.2	11.3	7.9	9.32	19.32	365 <sup>24hr</sup>
	NO <sub>x</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14	9	11.6	12.1	11.9	15.63	15.63	100 <sup>Annual</sup>
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	46	32	30	18	21	9	0	(10000) <sup>8hr</sup>
access road bridge	O <sub>3</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	9	4	9	1	5	19	11	157 <sup>8hr</sup>
	PM <sub>2.5</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	33.1	20.9	40.9	26.9	36.1	39.65	14.65	65 <sup>24hr</sup>
	PM <sub>10</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	118.1	83.7	128.3	112.9	137	142.84	79.92	150 <sup>24hr</sup>
	SPM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	142.5	106.2	177.8	168.2	163.2	171.2	109.25	200 <sup>8hr</sup>
	SO <sub>2</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	12.2	10.9	13.4	12.5	15.7	17.37	56.5	365 <sup>24hr</sup>
	NO <sub>x</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14.8	13.4	15	13	17.6	21.32	55.08	100 <sup>Annual</sup>
	CO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	38	34	32	23	21	8	0	(10000) <sup>8hr</sup>
	O <sub>3</sub>	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5	7	9	6	7	6	6	157 <sup>8hr</sup>

Note(s): Concentrations are in µg/m<sup>3</sup>

- DoE- Department of Environment, NF- Not found; NO-Not observed; x-not measured at pre-construction stage.

- Fine Particulate Matter (PM<sub>2.5</sub>), Respirable Dust Content (PM<sub>10</sub>), Suspended Particulate Matter (SPM), Oxides of Nitrogen (NO<sub>x</sub>). Sulfur dioxide (SO<sub>2</sub>), Carbone Monoxide (CO) & Ozone (O<sub>3</sub>);
- Standards for 1hr, 24hr or Annual are indicated using superscript;
- This monitoring was carried out by - Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550).
- All data presented here are 8 hrs. Monitoring data.

Table A.2: Baseline conditions of emission of different infrastructures and sources

		Cement Industry	Condensate Fractionating Plant	LPG Bottling Plant	Brick Field	Road Traffic	Small vessels, engine boat	Inland Water Cargo vessel	Sea going Mother Vessel (MV)	Fly ash Carrier	Clinkers Carrier	Clinker, Fly Ash Handling	Coal Carrier (MV)	Coal Ash Carrier (MV)	Coal Carrier (Lighter Vessel)	Coal Ash Carrier (Lighter Vessel)	Coal Loading and Unloading	Coal Handling (Stock Yard, Conveyor belt, etc)	BIF Power Plant (PP)	Other Coal Based PP	Other Fuel Based PP	Dredging and Land Filling	Earth excavation	Other Construction Activities	Residential sources
SW Corner of the PP area	PM	✓	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	✓	✓
	SO <sub>x</sub>	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	NO <sub>x</sub>	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	GHGs	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
Proposed Township area of the PP	PM	✓	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	X	✓
	SO <sub>x</sub>	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	NO <sub>x</sub>	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	GHGs	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
NW Corner of the PP area	PM	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	X	✓
	SO <sub>x</sub>	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	NO <sub>x</sub>	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	GHGs	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
Barni, Gaurambha	PM	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	✓
	SO <sub>x</sub>	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	NO <sub>x</sub>	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	GHGs	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
Chunkuri-2, Dacope	PM	✓	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓

		Cement Industry	Condensate Fractionating Plant	LPG Bottling Plant	Brick Field	Road Traffic	Small vessels, engine boat	Inland Water Cargo vessel	Sea going Mother Vessel (MV)	Fly ash Carrier	Clinkers Carrier	Clinker, Fly Ash Handling	Coal Carrier (MV)	Coal Ash Carrier (MV)	Coal Carrier (Lighter Vessel)	Coal Ash Carrier (Lighter Vessel)	Coal Loading and Unloading	Coal Handling (Stock Yard, Conveyor belt, etc)	BIF Power Plant (PP)	Other Coal Based PP	Other Fuel Based PP	Dredging and Land Filling	Earth excavation	Other Construction Activities	Residential sources
	SOx	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	NOx	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	GHGs	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
Pankhali, Dacope	PM	✓	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	✓
	SOx	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	NOx	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	GHGs	X	X	X	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓
	PM	✓	✓	✓	X	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	✓	X	X	X	✓
	SOx	X	✓	X	X	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	✓	X	X	✓	✓
	NOx	X	✓	X	X	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	✓	X	X	X	✓
	GHGs	X	✓	X	X	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	✓	X	X	X	✓
	PM	X	X	X	X	X	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X
Harbaria, Sundarbans	SOx	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NOx	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Akram Point Sundarbans	PM	X	X	X	X	X	✓	✓	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X
	SOx	X	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NOx	X	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	PM	X	X	X	X	X	✓	✓	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X
	SOx	X	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hiron Point Sundarbans	NOx	X	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	PM	✓	X	X	✓	✓	✓	✓	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	✓	✓
Khulna City, near Khan Jahan Ali Bridge	SOx	X	X	X	✓	✓	✓	✓	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	✓
	NOx	X	X	X	✓	✓	✓	✓	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	✓
	GHGs	X	X	X	✓	✓	✓	✓	X	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X	✓
Township area	PM	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	✓	✓	✓	

		Cement Industry	Condensate Fractionating Plant	LPG Bottling Plant	Brick Field	Road Traffic	Small vessels, engine boat	Inland Water Cargo vessel	Sea going Mother Vessel (MV)	Fly ash Carrier	Clinkers Carrier	Clinker, Fly Ash Handling	Coal Carrier (MV)	Coal Ash Carrier (MV)	Coal Carrier (Lighter Vessel)	Coal Ash Carrier (Lighter Vessel)	Coal Loading and Unloading	Coal Handling (Stock Yard, Conveyor belt, etc)	BIF Power Plant (PP)	Other Coal Based PP	Other Fuel Based PP	Dredging and Land Filling	Earth excavation	Other Construction Activities	Residential sources
Access road bridge area	SOx	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	NOx	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	GHGs	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√	√	√	√
	PM	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	√	√	√	√
	SOx	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	√	X	X	X	X	X	X
	NOx	X	X	X	X	√	X	X	X	X	X	X	X	X	X	X	X	X	√	X	X	X	X	X	X
	GHGs	√	√	X	√	√	X	X	X	X	X	√	X	X	X	X	X	X	√	X	X	√	√	√	√

Legend X-Absence of source or no emission

√-Presence of source, emission of pollutant

**(B) Water Quality Data**  
**Surface Water Quality Monitoring Data**  
**Table B.1: pH Values of Passur River Water**

SI	Sampling Locations	pH Values																					
		Apr 1QM	July 2QM	Oct 3QM	Jan 4QM	Apr 5QM	July 6QM	Oct 7QM	Jan 8QM	Apr 9QM	July 10QM	Oct 11QM	Jan 12QM	Apr 13QM	Oct 14QM	Jan 15QM	Apr 16QM	July 17QM	Nov 18QM	Feb 19QM	Apr 20QM	July 21QM	Nov 22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.1	7.9	7.6	7.8	7.6	7.1	7.5	7.27	6.9	7.6	7.2	7.1	8.28	8.1	8.4	7.9	8.18	9.0	6.8	7.9
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	7.2	7.0	8.2	8.0	7.7	7.9	7.58	7.3	7.8	7.3	7	7.5	7.3	6.9	8.25	8.1	8.4	6.04	8.03	9.9	6.8	7.8
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.2	6.9	8.0	8.1	7.8	7.8	7.64	7.3	7.2	7.93	7.2	7.8	7.3	6.9	8.17	8.1	8.4	8.09	8.06	8.7	7.1	7.8
4	Left Bank of Passur River at Project site-Jetty	7.9	7.1	8.1	7.9	7.5	7.9	7.6	7.1	7.4	7.56	7.3	8.2	7.2	6.9	8.2	8.1	8.3	7.65	7.78	8.9	7.5	7.5
5	Middle Passur River at Project site-Jetty	7.1	6.9	8.1	7.9	7.6	8	7.58	7.5	7.8	7.6	7	8.5	7.8	7.2	8.21	8.1	8.3	8.20	7.97	8.4	7.2	7.4
6	Right Bank of Passur River at Project site-Jetty	7.1	6.9	8.2	7.9	7.7	8	7.62	7.6	7.4	7.9	6.9	8.7	7.4	7.2	8.2	8.1	8.2	7.87	8.04	8.5	6.7	7.4
7	Left Bank of Passur River at South West corner from the Project boundary	7.4	7.0	8.1	7.6	7.5	8.1	7.78	8.1	7.6	7.94	7.2	8.1	6.9	7.2	8.39	8.0	8.4	8.11	7.89	9.3	7.4	7.3
8	Middle of Passur River at South West corner from the Project boundary	7.4	6.9	8.0	7.5	7.2	8	7.6	8	7.1	8.04	7.5	8.6	6.8	7.1	8.15	8.1	8.5	7.44	7.85	8.7	6.5	7.2
9	Right Bank of Passur River at South West corner from the Project boundary	7.3	6.8	8.0	7.8	7.3	8.1	7.64	7.9	7.2	8.2	7.3	8.9	7.1	7	8.16	8.1	8.5	7.07	8.06	8.4	7.3	7.2
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	7.4	6.9	8.1	7.7	7.5	8.1	7.3	7.3	7.1	8.1	6.8	8.1	7.2	7.1	8.4	8.1	8.6	7.94	8.05	9.3	7.2	7.4
11	Maidara river near proposed township area	7.4	6.8	8.1	7.3	7.6	6.9	7.56	7.1	7.4	7.8	7.1	7.6	7.4	7	7.92	7.6	7.3	7.631	7.8	8.2	7.0	7.3
12	Passur river at Passur-Ghasiakhali confluence	7.3	6.8	7.4	8.2	7.5	7.9	7.1	7.4	7.3	7.3	6.9	7.2	6.9	6.8	7.48	7.3	8.3	7.02	8.65	8.1	7.0	8.0
13	Passur river at Harbaria of Sundarbans	7.9	6.9	8.0	8.1	7.7	7.9	7.8	8.2	7.3	7.63	7.4	7.8	6.9	7.1	8.19	8.1	8.4	7.19	7.71	8.2	7.2	8.0
14	Passur river at Akram point of Sundarbans	7.2	6.9	7.9	8.1	7.7	NS	7.63	8	7.9	7.67	7.1	8.2	7.2	7.1	8.22	8.2	8.2	8	7.77	7.9	7.1	7.8
15	Passur river at Hiron po.000int of Sundarbans	7.2	7.0	7.0	8.1	7.7	NS	7.39	NS	7.8	NS	7.6	8.5	NS	6.8	8.2	NS	NS	7.18	7.79	NS	NS	7.8

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring, NS – Not Surveyed

**Table B.2: Surface Water Temperature in Passur River**

SI	Sampling Locations	Temperature (°C)																					
		Apr 1QM	Jul 2QM	Oct 3QM	Apr 4QM	Apr 5QM	Jul 6QM	Oct 7QM	Jan 8QM	Apr 9QM	Jul 10QM	Oct 11QM	Jan 12QM	Apr 13QM	Oct 14QM	Jan 15QM	Apr 16QM	Jul 17QM	Nov 18QM	Feb 19QM	Apr 20QM	July 21QM	Nov 22QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	19	30	31.8	31.2	22.0	31.2	29.6	30.1	22.8	30	29.8	19.7	30	30	28	22.02	31	30	27
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	31	33	31	20	30	30.5	31.8	21.0	31.1	29.1	30.8	22.5	30	30.1	19.8	30	30	26.85	21.96	31	30	27
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	31	33	30	20	30	30.5	30.9	21.0	30.8	29.4	30.4	22.1	29.8	30.2	20.2	31	30	27.49	21.82	31	30	27
4	Left Bank of Passur River at Project site-Jetty	31	33	31	19	31	30.8	31.3	22.0	31.4	30.1	30.1	22.8	31.3	30.1	20.3	28	30	27.49	21.82	31	30	28
5	Middle Passur River at Project Site-Jetty	30	32	31	19	30	30.6	31.6	22.0	30.9	30.5	31.0	21.8	30.0	29.8	20.3	29	30	27.97	22.55	31	31	28
6	Right Left Bank of Passur River at Project site-Jetty	30	32	31	19	30	30.4	31.1	21.0	31.0	30.5	31.1	21.9	30.0	29.9	20.3	28	31	28.05	22.35	31	30	28
7	Left Bank of Passur River at South West corner from the Project boundary	31	32	30	20	31	30.5	30.3	23.0	30.7	30.7	30.4	22.1	29.9	30.0	20.6	28	31	27.85	22.17	33	30	27
8	Middle of Passur River at South West corner from the Project boundary	31	31	29	19	30	30.8	30.5	22.0	30.4	29.8	30.2	22.0	29.8	30.1	20.2	28	31	28	22.27	31	30	27
9	Right Bank of Passur River at South West corner from the Project boundary	31	31	29	19	31	30.6	30.8	21.0	30.1	29.8	31.1	22.1	30.1	30.1	20.3	28	31	28	22.54	32	30	27
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	30	31	28	19	30	30.8	31.8	22.0	31.2	30.4	31.1	21.9	30.3	29.9	19.1	28	31	27.62	22.06	33	30	27
11	Maidara river near proposed township area	30	32	27	20	30	31.6	31.2	23.0	30.6	30.7	31.2	21.8	30.1	30.0	21.1	31	31	30.2	21	32	30	27
12	Passur river at Passur-Ghasiakhali confluence	29	30	32	19	30	29.8	30.7	21	31.3	30.7	30.38	22.1	30.2	30	20.8	30	29	26.82	21.89	31	30	28
13	Passur river at Harbaria of Sundarbans	30	30	27	22	30	29.0	30.8	22.0	31.5	30.9	29.9	23.1	30.2	29.8	21	30	29	27.62	21.81	31	31	30
14	Passur river at Akram point of Sundarbans	29	29	30	21	30	NS	30.2	21.0	30.8	30.4	30.4	22.5	30.8	29.9	21.2	32	30	27.21	22.42	31	31	29
15	Passur river at Hiron point of Sundarbans	29	30	29	21	30	NS	30.4	NS	31.4	NS	31.3	21.4	NS	29.4	21.2			28.66	23.78			31

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring, NS – Not Surveyed

**Table B.3: Salinity (ppt) in Passur River**

		Apr 1QM	Jul 2QM	Oct 3QM	Jan 4QM	Apr 5QM	Jul 6QM	Oct 7QM	Jan 8QM	Apr 9QM	Jul 10QM	Oct 11QM	Jan 12QM	Apr 13QM	Oct 14QM	Jan 15QM	Apr 16QM	Jul 17QM	Nov 18QM	Feb 19QM	Apr 20QM	July 21QM	Nov 22QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	2.5	0.0	4.5	13	0	0	4.1	8	0	0	3.7	6.3	0	2	11.5	0.2	0.9	11.1	16.6	0.5	0.4	No Specific standard for salinity has been mention-ed in the ECR'1997
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.3	0.0	4.1	15	0	0	4.3	7.4	0	0	3.8	5.9	0	2	11.5	0.2	0.1	11.1	16.2	0.2	0.3	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	11.5	0.2	0.0	4.5	16	0	0	4.3	7	0	0	3.6	6.2	0	2	11.5	0.4	0.8	10.6	16.5	0.3	0.3	
4	Left Bank of Passur River at Project site-Jetty	12.0	2.2	0.0	4.7	9	0	0	4.4	6	0	0	4	6.8	0	2.6	12.0	0.3	0.9	10.8	16.6	0.2	0.5	
5	Middle Passur River at Project site-Jetty	12.0	0.3	0.0	5.1	13	0	0	5.1	6.2	0	0	3.9	6.9	0	2.6	12.0	0.2	0.8	10.8	16.9	0.2	0.3	
6	Right Left Bank of Passur River at Project site-Jetty	12.0	0.5	0.0	5.0	14	0	0	5	9	0	0	4.2	6.1	0	2.7	12.0	0.2	0.8	11	16.9	1.2	0.3	
7	Left Bank of Passur River at South West corner from the Project boundary	9.5	4.0	0.0	5.2	14	0	0	5.2	8	0	0	4.2	6.5	0	2.8	9.5	0.2	1	9.9	12.0	0.3	2.1	
8	Middle of Passur River at South West corner from the Project boundary	9.0	0.0	0.0	5.2	13	0	0	4.9	7	0	0	4.1	7.1	0	2.8	9.0	0.3	0.2	11.5	16.7	0.2	0.1	
9	Right Bank of Passur River at South West corner from the Project boundary	10.0	2.5	0.0	5.1	12	0	0	5.5	6.8	0	0	4.1	7	0	2.8	10.0	0.3	0.3	11.1	16.9	0.3	0.4	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	10.0	0.5	0.0	5.2	10	0	0	3.8	7.1	0	0	3.9	7	0	2.6	10.0	0.3	0.9	11.3	16.5	0.3	0.3	
11	Maidara river near proposed township area	9.0	4.5	0.0	4.5	9	0	0	2.5	6.3	0	0	3.8	6.9	0	2.52	9.0	0.2	0.02	9.9	8.0	1.0	0.3	
12	Passur river at Passur-Ghasiakhali confluence	10.0	9.5	0.0	5.0	14	0	0	4.8	6	0	0	6.7	10.4	1.2	10.8	10.0	0.6	1	7.9	14.9	0.4	0.5	
13	Passur river at Harbaria of Sundarbans	12.0	10.0	0.0	6.0	15	0	0	5.3	8.9	0	0	8.9	10.4	2.3	2.8	12.0	2.2	1.8	11.9	15.6	0.3	0.7	



		Apr 1QM	Jul 2QM	Oct 3QM	Jan 4QM	Apr 5QM	Jul 6QM	Oct 7QM	Jan 8QM	Apr 9QM	Jul 10QM	Oct 11QM	Jan 12QM	Apr 13QM	Oct 14QM	Jan 15QM	Apr 16QM	Jul 17QM	Nov 18QM	Feb 19QM	Apr 20QM	July 21QM	Nov 22QM	
14	Passur river at Akram point of Sundarbans	19.0	15.0	1.0	16.0	20	NS	5	11.3	9.4	4	3	16.3	16	3.6	13.1	19.0	2.8	9.1	16.7	22.9	0.9	6.6	
15	Passur river at Hiron point of Sundarbans	23.0	19.5	2.0	23.0	25	NS	6.2	NS	14	NS	5.8	21.4	NS	5.1	16.45	23.0		13.9	22.7			9.2	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring, NS – Not Surveyed

**Table B.4: Dissolve Oxygen in Passur River**

SL	Sampling Locations	Dissolve Oxygen (mg/L)																						
		Apr 1QM	Jul 2QM	Oct 3QM	Jan 4QM	Apr 5QM	Jul 6QM	Oct 7QM	Jan 8QM	Apr 9QM	Jul 10QM	Oct 11QM	Jan 12QM	Apr 13QM	Oct 14QM	Jan 15QM	Apr 16QM	Jul 17QM	Nov 18QM	Feb 19QM	Apr 20QM	July 21QM	Nov 22QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.9	6.1	5.6	5.5	6.2	5.3	6.8	5.1	7.1	6.2	6	6.1	7.1	6.3	5.19	6.575	6.0	6.4	8.7	5.9	6.0	7.7	5 or more (standard for sustaining fisheries)
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	6.8	7.7	6.6	6.4	5	6.4	5.1	6.4	5.7	6.1	5.9	7.2	6.4	5.03	6.225	6.2	6.2	7.9	6.5	6.0	7.8	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	5.2	6.7	7.7	6.7	6.2	5	7.1	6.2	6.9	5.6	6	6.1	6.8	6.5	5.06	6.275	6.1	6.3	7.3	6.3	6.1	7.8	
4	Left Bank of Passur River at Project Site-Jetty	5.7	6.8	7.6	5.8	6.2	6.7	6.8	5.9	5.8	6.1	6.3	6.2	6.9	6.3	5.1	6.15	5.5	6	8.7	6.1	6.5	8.6	
5	Middle of Passur River at Project Site-Jetty	5.9	6.9	7.2	5.9	6.6	6.6	7.2	5.3	6.1	6.3	5.9	5.9	7.4	6.3	5.03	6.5	6.0	6.2	7.3	6.5	6.3	8.0	
6	Right Bank of Passur River at Project Site-Jetty	5.8	6.6	8.0	6.8	6.4	6	7.6	5.4	6.6	5.8	6.1	5.9	7.5	6.5	4.9	6.575	6.5	6	7.4	6.0	6.4	8.2	
7	Left Bank of Passur River at South West corner from the Project boundary	6.6	7.3	5.6	6.1	6.3	7.5	6.4	6	6.9	6.3	5.9	6.3	6.4	6.5	5	6.55	6.8	6.1	7.8	6.1	6.2	9.9	
8	Middle of Passur River at South West corner from the Project boundary	6.5	7.1	5.6	6.9	6.5	7.4	6.1	6.1	7.1	6.4	6	6.4	7.2	7.1	4.98	6.825	6.2	6.3	7.1	6.5	6.2	10.0	
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	7.2	5.8	6.6	6.4	7.3	6.3	5.8	6.8	5.6	6	6.4	6.8	6.5	5.11	6.625	6.0	6.2	6.9	6.1	6.3	10.5	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	6.0	6.5	8.0	6.0	6.2	6	7.1	4.1	6.4	5.2	6.1	6.7	6.8	6.3	5.17	6.35	6.7	5.8	7.5	6.3	6.4	7.1	
11	Maidara river near proposed township area	6.7	6.8	8.0	6.2	6.5	6.4	7.1	5.2	5.9	5.4	6.4	6.7	7.1	6.2	5.11	6.7	6.3	6	6.0	6.2	6.0	7.7	
12	Passur river at Passur-Ghasiakhal confluence	5.3	6.2	7.0	6.5	6.3	7	6.6	5.4	5.8	5.4	5.6	5.9	6.4	6.4	5.23	5.95	5.8	6	6.9	6.5	6.2	7.9	
13	Passur river at Harbaria of Sundarbans	5.4	5.9	7.0	6.6	5.8	7.5	7.1	5.2	6.4	5.4	5.8	6.1	6.4	6.2	5.03	5.8	6.9	8.21	7.5	6.9	6.0	8.4	
14	Passur river at Akram point of Sundarbans	7.9	6.4	7.7	6.7	6	NS	7.3	6.2	6.1	6.2	6.7	6.5	7.2	6.8	5.4	6	6.8	6.9	7.7	7.0	6.6	7.7	
15	Passur river at Hiron point of Sundarbans	7.5	6.5	7.8	6.5	5.8	NS	7	NS	7.1	6.8	6.9	6.8	NS	7.3	5.4	NS	NS	7.2	8.0	NS		8.6	

Source: CEGIS Field Survey-

Note: 1QM= First Quarterly Monitoring (April, 2014), 2QM = Second Quarterly Monitoring (July, 2014), 3QM = Third Quarterly Monitoring (October, 2014), 4QM = Fourth Quarterly Monitoring (January 2015)

**Table B.5: BOD<sub>5</sub> of Passur River Water**

SL	Sampling Locations	Apr 1QM	Jul 2QM	Oct 3QM	Jan 4QM	Apr 5QM	Jul 6QM	Oct 7QM	Jan 8QM	Apr 9QM	Jul 10QM	Oct 11QM	Jan 12QM	Apr 13QM	Oct 14QM	Jan 15QM	Apr 16QM	5 or more (standard for sustaining fisheries)
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	3.4	2.2	1.9	1.6	3.1	3	2.1	2.1	2.8	2.4	2.8	1.8	2.1	1.9	2.1	3	
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	4.9	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2.2	2.8	3.4	2.7	3.1	2.9	3.4	1.9	3	2.5	2.8	1.9	2.5	2.7	1.9	3	
4	Left Bank of Passur River at Project Site-Jetty	3.2	3.1	4.0	0.8	3	4.4	3.2	1.1	3.6	2.1	3.1	2.1	2.4	2.8	2.0	4	
5	Middle of Passur River at Project Site-Jetty	3.0	2.5	3.5	1.4	3.5	4.3	3.7	2.4	3.3	2.2	2.5	2.2	2.6	2.4	2.0	4	
6	Right Bank of Passur River at Project Site-Jetty	5.8	3.5	3.6	2.0	3.4	3.7	2.9	1.7	3.1	3.1	2.9	2.1	3.1	2.1	2.3	4	
7	Left Bank of Passur River at South West corner from the Project boundary	3.9	2.8	2.6	1.0	3.1	5.3	2.2	1.2	3.1	2.9	2.4	2.1	3.2	2.4	2.0	5	
8	Middle of Passur River at South West corner from the Project boundary	3.8	3.3	2.8	2.6	3.2	5.2	2.3	2.3	2.6	2.7	2.7	1.9	2.5	2.7	1.9	5	
9	Right Bank of Passur River at South West corner from the Project boundary	6.5	3.8	2.9	2.1	3.4	5	3.1	2.4	3	3.1	3.1	2.1	2.6	2.3	2.1	5	
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	3.2	3.3	5.5	1.5	3.2	3.9	4.2	2.7	3.3	3.4	2.8	1.8	3.4	2.4	2.1	4	
11	Maidara river near proposed township area	4.1	3.7	4.0	2.0	3.4	4.2	1.6	1.8	3.5	3.2	2.9	2.1	3.2	2.1	2.0	4	
12	Passur river at Passur-Ghasiakhal confluence	2.3	2.2	1.7	2.0	3.3	4.9	2.1	2.2	3.4	2.8	2.3	2	2.7	3.1	2.4	3.1	
13	Passur river at Harbaria of Sundarbans	2.2	2.5	2.6	1.9	2.4	3.9	2.7	2.1	3.2	2.8	2.7	2.1	2.7	3.1	2.9	2.3	
14	Passur river at Akram point of Sundarbans	3.4	2.2	1.9	1.6	3.1	3	2.1	2.1	2.8	2.4	2.8	1.8	2.1	1.9	2.1	3	
15	Passur river at Hiron point of Sundarbans	4.9	3.3	4.1	2.3	3.2	2.4	1.9	2.2	3.2	2.8	2.7	1.9	3.4	2.1	1.9	2	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring, NS – Not Surveyed

Table B.6: COD of Passur River System

SI	Sampling Locations	COD (mg/L)																				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	288	24	6	128	87	42	32	124	220	8	12	56	52	24	48	276	20	56	72	188	36
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	284	20	30	68	58	43	36	100	240	8	8	40	48	8	28	240	24	44	60	180	24
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	328	56	14	92	132	18	28	96	280	8	8	44	56	40	40	230	12	48	48	176	32
4	Left Bank of Passur River at Project Site-Jetty	376	28	18	84	102	26	36	100	280	8	12	48	40	32	36	232	30	60	44	192	20
5	Middle Passur River at Project Site-Jetty	400	60	14	116	110	21	36	108	240	12	16	52	36	40	32	254	16	36	56	180	28
6	Right Bank of Passur River at Project Site-Jetty	364	496	18	108	88	24	40	80	260	8	12	42	48	16	28	252	12	42	64	172	24
7	Left Bank of Passur River at South West corner from the Project boundary	364	108	10	104	96	32	42	100	240	12	8	56	42	48	40	212	10	48	88	200	28
8	Middle of Passur River at South West corner from the Project boundary	400	40	22	16	18	25	28	100	180	8	8	52	36	8	44	218	24	32	36	160	20
9	Right Bank of Passur River at South West corner from the Project boundary	408	120	10	100	106	25	48	124	200	12	12	44	52	4	36	230	16	28	68	180	32
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	276	32	10	116	88	51	40	100	160	8	8	36	44	16	40	180	40	36	72	160	24
11	Maidara river near proposed township area	284	96	26	84	94	36	42	108	210	30	8	48	40	32	32	252	20	42	68	172	20
12	Passur river at Passur - Ghasiakhali confluence	408	172	14	96	92	30	46	88	220	12	16	40	64	40	48	260	10	20	32	178	24
13	Passur river at Harbaria of Sundarbans	372	216	14	96	102	26	36	100	140	16	12	40	216	32	40	280	16	58	56	184	32
14	Passur river at Akram point of Sundarbans	536	520	54	316	302	NS	84	96	156	4	68	56	240	16	72	296	110	44	180	160	220
15	Passur river at Hiron point of Sundarbans	540	416	122	472	470	NS	96	NS	160	NS	56	196	NS	4	88	NS	NS	76	140	NS	NS

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.7: Oil and grease concentration of Passur River System

Sl	Sampling Locations	Oil and Grease (mg/L)																				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Left Bank of Passur River at South West corner from the Project boundary	<5	<5	<5	>15	16.9	9	<5	39	61	5	<5	9.2	5.73	<5	16.6	<5	<1	<2.0	<2.0	<2.0	<2.0
2	Passur-Ghasiakhali Confluence	<5	<5	<5	>15	13	7.63	9.87	21	30.3	13.5	<5	15.6	<5	<5	<5	<5	<5	<2.0	<2.0	<2.0	<2.0
3	Passur river at Harbaria of Sundarbans	<5	6.3	<5	>20	39.1	10.1	<5	14	26	5.73	<5	<5	<5	<5	<5	<1	<2.0	<2.0	<2.0	<2.0	
4	Passur river at Hiron point of Sundarbans	<5	<5	<5	>20	<5	NS	10.8	ND	31	NS	10.1	13.8	7.71	<5	<5	<5	NS	<2.0	<2.0	<2.0	<2.0
5	Akram Point of Sundarbans	<5	<5	<5	>20	<5	NS	9.73	36	82	5.87	<5	14.2	ND	<5	<5	<5	<1	<2.0	<2.0	<2.0	<2.0

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.8: TDS of Passur River System

SL	Sampling Locations	TDS (mg/L)																				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	13060	251	176	4360	14400	937	158	5570	13400	179	138	3100	13400	496	1913	14500	315	855	9940	15800	290
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	12630	246	162	3950	14700	941	169	5910	13280	112	106	3140	13480	122	1919	14420	224	733	9950	15600	150
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	12900	383	153	4330	14900	127	152	5490	13560	125	108	3330	13400	123	1915	14650	232	722	9730	15500	152
4	Left Bank of Passur River at Project site-Jetty	13190	445	169	4750	14600	175	172	5720	12830	162	147	3630	13560	172	2500	14300	328	824	9860	15700	205
5	Middle Passur River at Project site-Jetty	13330	353	156	4920	14500	132	162	5850	13100	185	110	3600	13490	125	2520	14450	235	716	9980	16000	142
6	Right Bank of Passur River at Project site-Jetty	13380	402	152	4870	14200	156	160	5480	13460	143	112	3520	13330	125	2500	14540	208	732	9800	16100	150
7	Left Bank of Passur River at South West corner from the Project boundary	13180	655	162	5040	14500	336	192	5650	12820	205	113	3470	13640	160	2840	14400	205	945	10190	15640	208
8	Middle of Passur River at South West corner from the Project boundary	13390	587	153	5050	14600	158	164	5740	12960	195	108	3790	13680	126	2710	14500	286	784	10280	16000	145
9	Right Bank of Passur River at South West corner from the Project boundary	13240	916	154	5130	14250	160	164	5650	13590	140	146	3770	13360	127	2720	14610	296	786	10080	15800	154
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	12400	455	214	5050	14000	2320	183	5450	13340	165	196	2920	13490	1616	2500	14160	265	992	10040	15700	940
11	Maidara river near proposed Township area	10970	2510	257	4390	13900	355	176	4420	11700	5170	238	3960	13110	1200	2970	14450	340	827	8860	15100	365
12	Passur river at Passur - Mongla confluence	12800	6410	209	5130	14050	298	227	4540	11330	893	162	3370	12340	204	2570	14500	580	940	8350	15722	172
13	Passur river at Harbaria of Sundarbans	12280	9360	285	4780	13900	683	205	4940	13580	1321	301	3370	13600	245	2690	15350	2190	1715	10950	15400	560
14	Passur river at Akram point of Sundarbans	21500	15960	3400	12350	13600	NS	4220	13330	20720	7330	2550	3580	19370	3270	11390	20600	7680	8100	17200	14800	12500
15	Passur river at Hiron point of Sundarbans	21500	14050	5720	17900	25300	NS	5830	NS	25500	NS	4120	12210	NS	4450	14190	NS	NS	12500	21110		

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.9: TH Passur River System

SL	Sampling Locations	TH (mg/L)																				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	2900	250	216	930	3000	245	250	1270	3130	240	255	1090	3640	200	430	3100	210	335	2050	3000	2100
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	2500	180	218	870	3050	110	330	1380	3090	205	250	980	3420	150	510	1040	205	310	3900	5000	1950
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	2650	170	335	870	3250	105	360	1240	3140	205	190	1030	3300	155	498	1030	185	313	4100	5000	1900
4	Left Bank of Passur River at Project site-Jetty	2550	175	390	940	3450	118	365	1220	3010	220	265	1020	3400	160	570	1060	200	285	4600	5200	1850
5	Middle Passur River at Project site-Jetty	2600	275	340	990	3250	103	355	1300	3070	232	237	915	3440	145	590	1040	210	255	4200	5000	2500
6	Right Bank of Passur River at Project site-Jetty	2625	350	355	970	3200	105	350	1260	3100	218	242	1070	3380	140	480	1085	215	275	4400	4800	2550
7	Left Bank of Passur River at South West corner from the Project boundary	2550	325	330	1045	3600	153	345	1370	3060	235	205	935	3540	150	505	1080	205	295	4400	4400	1700
8	Middle of Passur River at South West corner from the Project boundary	2800	350	345	1125	3670	105	390	1340	3130	242	217	1100	3480	155	530	1110	212	265	4300	5100	1850
9	Right Bank of Passur River at South West corner from the Project boundary	2500	475	325	975	3540	165	445	1270	3110	224	238	1110	3600	175	512	1100	205	325	4600	4900	2000
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	2500	450	350	980	3260	470	183	950	3180	220	250	1040	1960	165	505	1300	210	295	4000	5200	2000
11	Maidara river near proposed township area	2400	725	330	970	3190	130	340	1075	3080	875	240	1170	2300	320	478	1120	220	315	4100	5000	2200
12	Passur river at Passur - Mongla confluence	3150	1400	377	1000	3210	135	410	1090	3060	405	245	1070	2450	220	1070	1410	245	325	4000	4782	1800
13	Passur river at Harbaria of Sundarbans	2625	2150	345	970	3080	200	430	1100	3050	415	282	1070	3560	200	610	1330	530	2550	4500	4500	1400
14	Passur river at Akram point of Sundarbans	4500	3625	980	2380	3420	NS	1090	2850	4520	1750	670	1130	4300	640	1475	1440	2030	2750	5900	4500	4300
15	Passur river at Hiron point of Sundarbans	4850	3050	1440	2690	3640	NS	1460	NS	5050	NS	810	2870	NS	905	1740	NS	NS	4200	6900	NS	NS

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.10: TSS Passur River System

SL	Sampling Locations	TSS (mg/L)																				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	598	126	234	180	160	26	76	14	8	61	20	46	51	18	14	18	17	14	15	12	14
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	45	92	193	210	167	25	80	12	7	48	18	52	42	15	15	17	16	11	12	14	11
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	53	112	174	230	170	127	65	14	10	56	16	48	48	22	14	22	15	15	14	13	13
4	Left Bank of Passur River at Project site-Jetty	54	99	227	450	160	30	92	17	10	62	20	42	52	16	13	20	18	11	12	11	12
5	Middle Passur River at Project site-Jetty	60	100	232	250	165	27	85	18	8	45	24	54	43	20	13	19	16	13	13	12	13
6	Right Bank of Passur River at Project site-Jetty	55	105	186	200	155	40	97	22	7	49	19	46	38	17	14	21	15	12	15	15	14
7	Left Bank of Passur River at South West corner from the Project boundary	24	116	185	300	150	32	104	20	12	51	20	61	32	15	15	17	16	14	16	12	13
8	Middle of Passur River at South West corner from the Project boundary	27	112	536	530	147	40	90	7	10	43	18	58	44	16	17	19	14	13	13	11	12

SL	Sampling Locations	TSS (mg/L)																				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
9	Right Bank of Passur River at South West corner from the Project boundary	67	37	459	450	155	44	82	18	11	39	16	63	40	14	12	18	20	15	14	13	13
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	7	65	798	280	148	36	96	11	7	42	24	55	37	26	14	23	13	11	14	14	15
11	Maidara river near proposed township area	9	24	389	206	160	28	92	10	6	11	30	66	49	30	15	32	12	42	8	12	12
12	Passur river at Passur - Mongla confluence	50	310	203	280	165	24	60	15	13	47	27	61	38	25	13	14	17	27	15	13	13
13	Passur river at Harbaria of Sundarbans	65	90	869	400	160	42	74	22	18	31	18	61	33	27	17	15	13	22	12	11	12
14	Passur river at Akram point of Sundarbans	115	99	28	103	150	NS	110	16	23	16	41	34	28	22	14	18	14	15	11	10	7
15	Passur river at Hiron point of Sundarbans	91	72	267	200	180	NS	144	NS	15	NS	33	49	NS	16	13	NS	NS	6	9		

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

**Table B.11: NO<sub>3</sub><sup>2-</sup> concentration of Passur River System**

SI	Sampling Locations	NO <sub>3</sub> <sup>2-</sup> (mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.9	2.89	0.32	3	33	9.1	4	6.3	3	3.9	0.25	3.62	4.35	5.8	3	6.8	0.8	2.8	3.5	0.3	0.1	
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	0.7	2.4	1.57	1.5	13	7.5	7.1	4.3	2.9	6.2	0.39	2.89	5.05	6.8	4.2	4.9	1.7	0.1	2.6	0.3	1.1	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.1	3.2	1.84	4.3	39	6.2	5	3.9	2.5	4.3	0.42	1.87	4.55	4.5	3.6	5.1	2.1	0.11	1.9	3.7	1.2	
4	Left Bank of Passur River at Project site-Jetty	1.3	0.76	1.64	3.1	48	6.6	5.7	3.1	2	5.1	0.76	2.25	6.11	7.1	3	2.8	2.8	1.7	2.1	3.0	1.5	
5	Middle Passur River at Project site-Jetty	1.4	2.69	1.42	2.2	69	6.1	3.3	5.2	3.1	2.7	0.52	2.46	3.4	3.1	4.7	5.2	1.8	0.9	2.2	1.2	1.5	
6	Right Bank of Passur River at Project site-Jetty	1.1	2.98	1.33	8.5	8	6.6	4.7	4.1	3.6	3.9	0.31	3.01	3.16	5	7.6	5.5	3.2	0.1	3.5	4.8	2.1	
7	Left Bank of Passur River at South West corner from the Project boundary	0.75	2.13	1.85	2.7	87	14.9	4.4	4.9	2.6	3.6	0.2	3.64	3.14	4.1	8.8	2.6	4	0.1	4.2	0.5	1.5	
8	Middle of Passur River at South West corner from the Project boundary	1.1	2.43	2.09	1.8	48	4	6.2	3.7	2.9	5.1	0.41	1.93	3.34	3.4	8.5	4.5	3.7	3.4	3.0	3.4	1.7	
9	Right Bank of Passur River at South West corner from the Project boundary	1.2	2.05	2.21	1.9	128	4.9	4.4	4.4	2.6	4.9	0.63	2.17	2.00	3.1	2.8	5.3	3.8	0.7	3.1	4.1	0.5	
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.3	2.18	2.26	6	62	7	4.9	5.6	2.7	5.2	0.4	2.46	3.61	2.3	1.6	5.9	4.4	2.3	2.1	5.0	3.1	
11	Maidara river near proposed township area	0.5	0.88	1.98	4	48	3.1	2.9	3.9	3.1	5.3	0.32	3.1	1.60	3.2	3.4	3.9	3.1	0.12	1.3	2.9	2.5	
12	Passur river at Passur - Mongla confluence	0.6	1.52	1.64	4.5	29	7.8	3.1	3.7	3	5.2	0.27	2.78	2.49	3.5	4.5	4.7	2.4	1.6	3.7	2.7	1.8	
13	Passur river at Harbaria of Sundarbans	1.4	1.75	1.67	2.7	18	4.4	4.4	5.1	3.4	5.1	0.39	2.78	2.46	4.2	4.6	5.2	2.7	0.1	4.7	4.4	1.7	
14	Passur river at Akram point of Sundarbans	2.7	3.32	0.59	1.5	25	NS	3.2	4.9	2.9	5.4	0.25	3.08	3.69	2.2	1.8	5.5	4.2	0.1	1.8	2.7	1.3	
15	Passur river at Hiron point of Sundarbans	0.8	2.84	0.4	2	28	NS	11.5	NS	3.5	NS	0.38	2.28	NS	2.6	6.1	NS	NS	0.9	2.6	NS	NS	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

**Table B.12: SO<sub>4</sub><sup>2-</sup> concentration of Passur River System**

SI	Sampling Locations	SO <sub>4</sub> <sup>2-</sup> (mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	1840	20	26	580	1360	67	7	570	1080	18	5	230	422	29	630	1400	24	51	760	1460	23	
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	1320	23	28	450	1260	11	8	590	1040	10	3	210	460	3	370	1320	18	49	756	1380	19	
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1280	36	34	480	1240	9	11	560	1020	13	4	200	1340	5	410	1440	20	46	764	1420	21	
4	Left Bank of Passur River at Project site-Jetty	1360	45	33	550	1240	26	10	550	1060	15	4	230	1380	2	310	1260	22	52	748	1410	16	
5	Middle Passur River at Project site-Jetty	1040	32	30	520	1120	6	8	580	980	17	6	280	1280	1	310	1200	21	38	760	1440	17	
6	Right Bank of Passur River at Project site-Jetty	1320	20	27	540	820	8	9	565	1100	14	5	230	1400	2	490	1400	16	42	762	1400	19	
7	Left Bank of Passur River at South West corner from the Project boundary	1640	60	40	630	880	9	12	640	1060	15	6	230	880	2	700	1300	10	56	768	1500	15	
8	Middle of Passur River at South West corner from the Project boundary	1520	40	35	560	1180	19	8	560	1020	18	5	231	1440	1	340	1380	24	52	760	1450	16	
9	Right Bank of Passur River at South West corner from the Project boundary	1280	80	64	620	900	12	6	550	1080	12	8	250	1340	3	340	1240	22	39	770	1460	14	
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	1120	20	63	570	1220	72	11	96	1040	11	14	160	1220	120	270	1200	21	65	758	1500	18	
11	Maidara river near proposed township area	1320	210	63	460	840	27	9	480	1020	480	14	200	1340	76	350	1250	18	46	760	1490	12	
12	Passur river at Passur - Mongla confluence	1360	620	44	630	980	39	13	482	1100	42	14	220	1220	5	280	1260	28	30	765	1446	14	
13	Passur river at Harbaria of Sundarbans	1560	860	69	590	900	51	7	500	1080	60	19	220	1300	13	220	1300	35	20	756	1500	16	
14	Passur river at Akram point of Sundarbans	2600	1400	1390	850	1540	NS	84	760	1650	620	190	230	1420	30	760	1460	620	250	764	1500	980	
15	Passur river at Hiron point of Sundarbans	2080	1160	2360	1500	1920	NS	97	NS	2100	NS	320	1090	NS	2	510	NS	NS	780	769	NS	NS	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.



Table B.13: PO<sub>4</sub><sup>2-</sup> concentration of Passur River System

SI	Sampling Locations	PO <sub>4</sub> <sup>2-</sup> (mg/L)																				July 21QM
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.52	2.23	0.67	0.32	0.86	10	1.27	0.269	0.22	1.14	3.39	0.67	1.31	0.49	0.21	0.38	1.03	0.25	0.25	0.25	10.1
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.5	1.99	1.12	0.61	0.53	0.23	1.97	0.269	0.36	1.76	4.11	0.31	1.72	2.5	0.16	0.25	0.83	0.3	0.30	0.32	0.6
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1.1	2.55	0.95	0.7	0.72	0.67	1.94	0.179	0.27	1.77	4.58	0.09	2.73	2.8	0.3	0.29	0.76	0.22	0.17	0.40	0.5
4	Left Bank of Passur River at Project site-Jetty	2.1	0.45	0.92	0.43	0.49	0.27	2.53	0.357	0.31	2.31	2.76	0.07	2.77	3.3	0.19	0.38	0.88	0.24	0.20	0.30	0.6
5	Middle Passur River at Project site-Jetty	2.2	2.13	1.11	0.41	0.68	0.59	1.3	0.536	0.3	0.98	3.2	0.12	0.66	3.9	0.17	0.34	1.07	0.4	0.35	0.27	0.6
6	Right Bank of Passur River at Project site-Jetty	2	2.42	0.99	0.55	0.61	0.13	1.32	0.269	0.43	1.01	2.48	0.16	0.62	3.9	0.47	0.27	0.67	0.53	0.27	0.25	0.9
7	Left Bank of Passur River at South West corner from the Project boundary	0.57	1.25	1.18	0.76	0.65	0.1	0.99	0.536	0.63	0.87	4.16	0.09	0.65	4.6	1.31	0.29	1.16	0.32	0.20	0.41	11.1
8	Middle of Passur River at South West corner from the Project boundary	1.2	1.51	1.25	0.85	0.53	0.18	1.02	0.625	0.21	0.96	2.76	0.04	0.37	0.41	0.39	0.29	0.86	0.43	0.20	0.35	0.8
9	Right Bank of Passur River at South West corner from the Project boundary	1.5	1.1	1	0.53	0.6	0.1	1.39	0.536	0.33	1.123	2.71	0.07	0.45	0.63	0.62	0.42	1.03	0.57	0.37	0.27	0.8
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.55	2.1	1.27	0.59	0.7	0.5	1.27	0.351	0.19	1.06	2.836	0.07	0.61	0.51	0.38	0.24	0.83	0.27	0.40	0.28	0.5
11	Maidara river near proposed township area	1.1	0.53	1.04	0.64	0.55	0.29	1.28	0.269	0.13	1	5.23	0.2	0.47	15.3	0.71	0.28	1.2	0.22	0.28	0.30	0.8
12	Passur river at Passur - Mongla confluence	1.3	0.35	0.86	0.42	0.71	0.59	0.95	0.179	0.31	0.78	4.01	0.09	0.18	1.3	0.63	0.37	0.86	0.33	0.29	0.31	0.6
13	Passur river at Harbaria of Sundarbans	1.1	0.56	1.22	0.61	0.59	0.89	0.35	0.269	0.42	0.53	1.16	0.09	0.21	3.15	0.81	0.26	0.5	0.25	0.30	0.52	0.6
14	Passur river at Akram point of Sundarbans	1.3	0.29	0.8	0.42	0.61	NS	0.43	0.357	0.26	0.47	9.08	0.1	0.19	0.36	0.97	0.20	0.67	0.5	0.19	0.63	0.5
15	Passur river at Hiron point of Sundarbans	7.51	0.29	1.09	0.44	0.47	NS	0.45	NS	0.36	NS	5.9	0.23	NS	0.55	1.45	NS	NS	0.61	0.18	NS	NS

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Table B.14: As concentration of Passur River System

SI	Sampling Locations	As (mg/L)																				July 21QM
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.004	0.003	0.002	0.003	0.002
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.002	0.003	0.004	0.003	0.002	0.002	0.001	0.001	0.003	0.003	0.003	0.001	0.002	0.001	0.002	0.001	0.005	0.002	0.001	0.002	0.002
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.001	0.003	0.004	0.003	0.003	0.002	0.001	0.001	0.003	0.005	0.002	0.001	0.001	0.002	0.003	0.001	0.004	0.002	0.003	0.003	0.002
4	Left Bank of Passur River at Project site-Jetty	0.002	0.004	0.004	0.004	0.002	0.002	0.001	0.002	0.002	0.004	0.002	0.002	0.001	0.002	0.002	0.002	0.005	0.002	0.001	0.003	0.002
5	Middle Passur River at Project site-Jetty	0.002	0.004	0.004	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.003	0.002	0.001	0.003	0.002
6	Right Bank of Passur River at Project site-Jetty	0.002	0.003	0.003	0.003	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.003	0.002	0.002	0.002	0.001	0.002	0.003	0.002
7	Left Bank of Passur River at South West corner from the Project boundary	<0.001	0.003	0.006	0.003	0.002	0.002	0.001	0.002	0.001	0.003	0.002	0.002	0.002	0.003	0.001	0.002	0.005	0.002	0.003	0.003	0.003
8	Middle of Passur River at South West corner from the Project boundary	<0.002	0.004	0.004	0.003	0.002	0.002	0.001	0.001	0.002	0.003	0.003	0.001	0.002	0.002	0.001	0.001	0.003	0.002	0.001	0.002	0.002
9	Right Bank of Passur River at South West corner from the Project boundary	0.002	0.003	0.006	0.003	0.002	0.003	0.001	0.001	0.002	0.004	0.002	0.002	0.003	0.002	0.001	0.001	0.004	0.002	0.001	0.002	0.002
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	<0.001	0.003	0.006	0.004	0.003	0.002	0.001	0.002	0.002	0.005	0.002	0.001	0.003	0.003	0.002	0.002	0.004	0.001	0.002	0.003	0.003
11	Maidara river near proposed township area	0.002	0.002	0.003	0.003	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.003	0.001	0.001	0.001	0.003	0.001	0.005	0.003	0.004
12	Passur river at Passur - Mongla confluence	0.002	0.004	0.003	0.003	0.004	0.002	0.001	0.002	0.003	0.004	0.003	0.002	0.002	0.002	0.001	0.002	0.003	0.001	0.007	0.003	0.002
13	Passur river at Harbaria of Sundarbans	0.004	0.003	0.004	0.004	0.004	0.002	0.001	0.002	0.005	0.002	0.003	0.002	0.001	0.003	0.002	0.001	0.003	0.002	0.001	0.002	0.001
14	Passur river at Akram point of Sundarbans	0.004	0.002	0.002	0.003	0.002	NS	0.001	0.002	0.006	0.001	0.003	0.001	0.002	0.002	0.001	0.002	0.002	0.001	0.002	0.002	0.001
15	Passur river at Hiron point of Sundarbans	0.003	0.002	0.003	0.002	0.002	NS	0.001	NS	0.004	NS	0.002	0.002	NS	0.002	0.001	NS	NS	0.001	0.001	NS	NS

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed



Table B.15: Pb concentration of Passur River System

SI	Sampling Locations	Pb (mg/L)																				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.053	0.004	0.002	0.104	0.098	0.0059	0.007	0.168	0.203	0.01	0.009	0.024	0.002	0.003	0.001	0.002	0.002	0.003	0.004	0.003	0.001
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	0.055	0.002	0.003	0.104	0.102	0.0038	0.006	0.092	0.302	0.009	0.007	0.034	0.001	0.003	0.001	0.001	0.001	0.007	0.005	0.002	0.003
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	0.055	0.005	0.002	0.111	0.138	0.0058	0.008	0.176	0.347	0.017	0.01	0.03	0.003	0.003	0.002	0.004	0.02	0.017	0.007	0.004	0.002
4	Left Bank of Passur River at Project site-Jetty	0.057	0.002	0.003	0.154	0.142	0.011	0.01	0.115	0.336	0.014	0.007	0.036	0.001	0.002	0.002	0.001	0.018	0.013	0.005	0.003	0.009
5	Middle Passur River at Project site-Jetty	0.06	0.002	0.002	0.139	0.135	0.002	0.009	0.148	0.317	0.006	0.006	0.046	0.003	0.002	0.001	0.003	0.008	0.01	0.003	0.003	0.003
6	Right Bank of Passur River at Project site-Jetty	0.058	0.002	0.002	0.138	0.156	0.0021	0.007	0.112	0.298	0.01	0.005	0.041	0.002	0.001	0.001	0.001	0.041	0.012	0.007	0.002	0.009
7	Left Bank of Passur River at South West corner from the Project boundary	0.053	0.002	0.003	0.16	0.142	0.0076	0.01	0.134	0.396	0.007	0.006	0.048	0.003	0.001	0.001	0.007	0.012	0.011	0.003	0.002	0.120
8	Middle of Passur River at South West corner from the Project boundary	0.054	0.003	0.004	0.153	0.148	0.002	0.011	0.099	0.323	0.006	0.007	0.044	0.009	0.002	0.001	0.003	0.015	0.014	0.004	0.003	0.006
9	Right Bank of Passur River at South West corner from the Project boundary	0.056	0.005	0.004	0.139	0.163	0.002	0.009	0.093	0.331	0.012	0.007	0.056	0.003	0.002	0.002	0.005	0.03	0.019	0.006	0.002	0.004
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	0.053	0.004	0.004	0.143	0.135	0.002	0.07	0.023	0.35	0.008	0.008	0.038	<LOQ	0.003	0.002	0.002	0.01	0.008	0.004	0.002	0.003
11	Maidara river near proposed township area	0.048	0.004	<0.002	0.133	0.14	0.002	0.008	0.067	0.275	0.015	0.007	0.056	0.001	0.011	0.001	0.003	0.016	0.017	0.005	0.003	0.004
12	Passur river at Passur - Mongla confluence	0.05	0.032	<0.002	0.141	0.14	0.002	0.009	0.078	0.258	0.098	0.011	0.05	0.0001	0.011	0.001	0.002	0.015	0.009	0.007	0.003	0.002
13	Passur river at Harbaria of Sundarbans	0.043	0.044	0.004	0.137	0.13	0.002	0.012	0.135	0.228	0.02	0.01	0.05	0.001	0.005	0.003	0.003	0.017	0.009	0.015	0.002	0.006
14	Passur river at Akram point of Sundarbans	0.194	0.071	0.032	0.309	0.297	NS	0.084	0.302	0.359	0.142	0.126	0.033	0.009	0.004	0.169	0.001	0.062	0.018	0.013	0.002	0.001
15	Passur river at Hiron point of Sundarbans	0.224	0.05	0.07	0.309	0.291	NS	0.073	NS	0.607	NS	0.151	0.129	NS	0.019	0.175	NS	NS	0.014	0.017	NS	NS

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring; NS – Not Surveyed.

Table B.16: Hg concentration of Passur River System

SI	Sampling Locations	Hg (mg/L)																				
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Left Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
2	Middle Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
4	Left Bank of Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
5	Middle Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
6	Right Bank of Passur River at Project site-Jetty	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
7	Left Bank of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
8	Middle of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

SI	Sampling Locations	Hg (mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	
9	Right Bank of Passur River at South West corner from the Project boundary	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
10	Maidara river of the South East corner of the project at Ichamoti-Maidara confluence	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
11	Maidara river near proposed township area	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
12	Passur river at Passur - Mongla confluence	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
13	Passur river at Harbaria of Sundarbans	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
14	Passur river at Akram point of Sundarbans	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
15	Passur river at Hiron point of Sundarbans	< 0.00015	NS	< 0.00015	< 0.00015	< 0.00015	< 0.00015	NS	NS	< 0.00015	NS	< 0.00015	< 0.00015	< 0.001	< 0.001	< 0.001	NS	NS	< 0.001	< 0.001	NS	< 0.001	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

### Parameters for ground water quality monitoring

Table B.17: pH and Temperature of Ground Water

SI	Locations	Tube Well Type	pH value																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Near Proposed Township	Deep (>600 ft)	7.6	7.7	7.9	8	TC	8.1	7.49	7.6	7.8	7.8	8.4	8.1	7.4	8.2	6.9	NF	NF	MF	7.1	8.3	8.2
2	Rajnagar	Deep (>600 ft)	7.6	7.8	8	8.2	7.8	8.3	7.93	8.1	8.3	8.1	7.9	7.5	7.8	8.1	7.4	6.9	7.9	7.3	6.9	8.4	7.9
3	Kapasdanga	Deep (>600 ft)	7.6	7.7	8	8.1	7.9	8.3	7.7	7.9	8.2	7.9	7.9	7.6	7.4	7.8	7.2	7.2	7.6	7.6	6.5	8.9	8.1
4	Kalekharber	Shallow (<250 ft)	6.3	6.5	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

Locations	Tube Well Type	Temperature (°C)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
Near Proposed Township	Deep (>600 ft)	27.3	28.5	26	24.5	TC	31	30	24	29.8	28.6	29.1	25.1	28.7	27.2	22.9	NF	NF	NF	23.8	29	31.4	27
Rajnagar	Deep (>600 ft)	29.6	29.9	28	22.5	28.6	28	27.8	23	29.6	29.1	30.4	24.3	27.7	26.5	23.8	30.3	29.3	30	23.7	30	30.0	27
Kapasdanga	Deep (>600 ft)	29.2	28.9	28	25.1	28.8	30	28.7	25	30.1	29.4	29.8	24	28.4	26.4	23.6	30.1	29.7	29	23.2	30	31.2	26
Kalekharber	Shallow (<250 ft)	27.5	28.7	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

NF=Non-functional \*Drinking water quality standards, The Environment Conservation Rules, 1997

Table B.18: Salinity and DO in Groundwater

SI	Locations	Tube Well Type	Salinity (ppt)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Near Proposed Township	Deep (>600 ft)	0	0	0	1	TC	0	0	0	0	0	0	0	0	0	0	NF	NF	NF	0.1	0.1	0.1	0.0
2	Rajnagar	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.3	0.1	0.1	0.1	0.5	0.1	0.0
3	Kapashdanga	Deep (>600 ft)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0.2	0.1	0.1	0.1	0.7	0.1	0.0
4	Kalekharber	Shallow (<250 ft)	0	0	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

SI	Locations	Tube Well Type	DO (mg/L)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	Nov
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Near Proposed Township	Deep (>600 ft)	4.4	5.2	6.5	6.7	TC	6	5.4	4.9	6.1	5.8	6.3	4.5	5.1	6.2	5.2	NF	NF	NF	6.0	6.0	6.1	6.0
2	Rajnagar	Deep (>600 ft)	6	6.2	7.7	6.3	6	5.9	6.1	5.2	5.8	6.1	5.8	4.8	5.3	5.8	4.47	6.0	6	5.9	6.1	6.5	6.0	6.2
3	Kapasdanga	Deep (>600 ft)	6.4	6.5	6.1	6.5	6.6	6	5.6	4.8	5.6	5.7	6.1	4.6	5.7	6.2	4.26	5.4	5.9	6.1	6.2	6.2	6.0	6.0
4	Kalekharber	Shallow (<250 ft)	4.4	6	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

NF=Nonfunctional \*Drinking water quality standards, The Environment Conservation Rules, 1997

Table B.19: TDS and TSS concentrations in Groundwater

SL	Locations	Type of tube wells	TDS (mg/L)																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Township near project site	Deep (>600 ft)	1113	999	-	1021	NO	881	377	447	1025	1000	617	623	395	602	405	NF	NF	NF	1315	915	25
2	Rajnagar	Deep (>600 ft)	4090	371	-	378	390	574	1007	491	384	408	382	401	617	996	602	615	390	365	376	380	602
3	Kapasdanga	Deep (>600 ft)	643	635	-	600	600	328	611	284	645	607	636	998	558	390	994	370	608	610	927	610	360
4	Kalekharber	Shallow (<250 ft)	1055	970	-	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS – Not Surveyed.

SL	Locations	Type of tube wells	TSS (mg/L)																					
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July	
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	
1	Township near project site	Deep (>600 ft)	-	6	19	40	NF**	23	4	31	3	5	7	32	4	8	12	NF	NF	NF	3	3	2QM	
2	Rajnagar	Deep (>600 ft)	-	6	2	28	4	16	5	46	4	4	4	28	10	10	6	12	2	6	3	2	1	
3	Kapasdanga	Deep (>600 ft)	-	8	6	32	6	14	4	41	3	4	5	25	9	9	7	5	3	8	4	4	4	
4	Kalekharber	Shallow (<250 ft)	-	48	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS=Not Surveyed; NF=Non functional;

Table B.20: TH concentrations in Groundwater

SI No	Locations	Type of tubewell	TH (mg/L)*																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Township near project site	Deep (>600 ft)	425	250	300	235	NO	225	325	295	305	320	175	550	720	145	NF	NF	NF	NF	355	235	97
2	Rajnagar	Deep (>600 ft)	220	175	180	110	138	125	450	195	263	248	295	510	420	240	265	195	235	178	215	182	167
3	Kapasdanga	Deep (>600 ft)	190	140	180	125	216	115	480	225	163	28	183	620	654	215	305	215	170	138	270	167	212
4	Kalekarber	Shallow (<250 ft)	780	450	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

NF=Nonfunctional; \*Drinking water quality standards, The Environment Conservation Rules, 1997

**Table B.21: COD concentrations of monitored ground water locations**

SI	Locations	Tube-well Type	COD (mg/L)																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Township near project site	Deep (>600 ft)	32	32	34	20	NO	12	4	4	4	4	4	4	4	8	NF	NF	NF	NF	4	352	4
2	Rajnagar	Deep (>600 ft)	28	28	18	16	14	10	8	4	4	4	4	4	4	8	4	4	4	4	3	4	4
3	Kapasdanga	Deep (>600 ft)	48	32	34	20	18	14	4	4	4	2	4	4	4	16	4	4	4	4	4	4	4
4	Kalekarber	Shallow (<250 ft)	32	36	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS=Not Surveyed; NF=Non functional; N/A=Not Availability; \*Drinking water quality standards, The Environment Conservation Rules, 1997

**Table B.22: NO<sub>3</sub><sup>-</sup> Concentrations in Ground Water**

SI	Locations	Type of tube well	NO <sub>3</sub> <sup>2-</sup> (mg/L) *BD Standard (10 mg/L)																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Township near project site	Deep (>600 ft)	0.20	0.48	<0.10	28	-	7.6	4.3	2.1	1.7	3.8	6.1	4.65	9.32	3.3	5.9	NF	NF	NF	1.7	4.4	1.4
2	Rajnagar	Deep (>600 ft)	0.60	0.68	0.31	26	-	2.2	4.2	1.9	2.3	3.3	7.51	7.02	14.7	2.5	7.2	5.3	8.6	0.9	4.4	2.7	2.7
3	Kapasdanga	Deep (>600 ft)	0.80	0.40	0.80	13	-	4.7	3.8	2.8	1.9	3.7	10.16	4.65	10.2	4.6	1.7	5.7	7.8	1.4	2.1	8.3	1.7
4	Kalekarber	Shallow (<250 ft)	0.40	0.56	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

NF=Nonfunctional; \*Drinking water quality standards, The Environment Conservation Rules, 1997

**Table B.23: SO<sub>4</sub><sup>2-</sup> Concentrations in Ground Water**

SI	Location	Type of Tubewell	SO <sub>4</sub> <sup>2-</sup> (mg/L) *BD Standard (400 mg/L)																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Township near project site	Deep (>600 ft)	-	3	-	-	-	-	1	5	1	1	1	1	5	1	8	NF	NF	NF	1	4	1
2	Rajnagar	Deep (>600 ft)	-	2	-	-	-	-	2	6	2	1	1	1	1	1	2	2	4	1	2	1	2
3	Kapasdanga	Deep (>600 ft)	-	10	-	-	-	-	2	2	8	1	1		3	2	6	4	6	1	1	4	1
4	Kalekarber	Shallow (<250 ft)	NF	3	NF	-	-	-	-	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

NF=Nonfunctional; \*Drinking water quality standards, The Environment Conservation Rules, 1997

Table B.24: PO43- Concentrations in Ground Water

SI	Location	Typeof Tubewell	PO <sub>4</sub> <sup>2-</sup> (mg/L) *BD Standard (6.0 mg/L)																				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
			1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM
1	Township near project site	Deep (>600 ft)	NF	2.2	-	0.74	NO	1.4	0.31	0.267	1.08	0.17	0.167	1.18	2.18	1.68	0.13	NF	NF	NF	2.1	2.3	0.3
2	Rajnagar	Deep (>600 ft)	-	2.5	-	0.44	1.98	1.6	0.27	0.179	1.53	0.29	0.67	1.21	1.8	3.5	0.17	4.5	2.9	0.15	1.3	2.5	4.0
3	Kapasdanga	Deep (>600 ft)	-	6.2	-	0.48	4.54	4.1	0.48	0.179	3.26	0.31	0.6	1.18	2.1	4.7	0.18	0.27	4.8	0.26	3.6	3.2	2.0
4	Kalekarber	Shallow (<250 ft)	NF	1.2	NF	NF	NF	NF	NF	NF	NF	NF	NF	1.23	NF	NF	NF	NF	NF	NF	NF	NF	NF

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring:

NF=Nonfunctional; \*Drinking water quality standards, The Environment Conservation Rules, 1997

Table B.25: As concentrations (mg/L) of monitored ground water locations

SI	Locations	As (mg/L) *BD Standard (0.05 mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	21QM
1	Township near project site	0.013	0.020	0.012	0.014	NO	0.015	0.002	0.008	0.018	0.012	0.033	0.028	0.012	0.014	0.002	0.001	NF	NF	0.014	0.012	0.014	0.001
2	Rajnagar	0.006	0.009	0.006	0.008	0.01	0.014	0.012	0.002	0.007	0.018	0.011	0.005	0.022	0.004	0.012	0.022	0.012	0.007	0.003	0.012	0.006	0.027
3	Kalekarber	0.376	0.407	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
4	Kapasdanga	0.036	0.033	0.020	0.017	0.034	0.024	0.011	0.002	0.047	0.005	0.016	0.028	0.010	0.027	0.002	0.001	0.004	0.050	0.004	0.012	0.022	0.001

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS=Not Surveyed; NF=Non-functional; N/A=Not Availability; TC=temporarily closed, D=Damaged

\*Drinking water quality standards, The Environment Conservation Rules, 1997.

Table B.26: Pb concentrations (mg/L) of monitored ground water locations

SI	Locations	Pb (mg/L) *BD Standard (0.05 mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	22QM
1	Township near project site	0.002	<0.002	0.004	0.023	NO	0.002	0.006	0.026	0.019	0.002	0.001	0.01	0.001	0.003	0.001	0.001	0.001	NF	NF	0.008	0.004	0.018
2	Rajnagar	<0.002	<0.002	<0.002	0.016	0.013	0.0027	0.021	0.011	0.007	0.002	0.001	0.009	0.001	0.007	0.002	0.001	0.001	0.001	0.004	0.003	0.004	0.002
3	Kalekarber	0.002	0.008	NF	NF	D	D	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
4	Kapasdanga	<0.002	0.004	<0.002	0.013	0.017	0.002	0.005	0.012	0.008	0.002	0.001	0.016	0.001	0.002	0.001	0.001	0.001	0.001	0.056	0.004	0.006	0.001

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS=Not Surveyed; NF=Non-functional; N/A=Not Availability; TC=temporarily closed, D=Damaged

\*Drinking water quality standards, The Environment Conservation Rules, 1997

Table B.27: Hg concentrations (mg/L) of monitored ground water locations

SI	Locations	Hg (mg/L) *BD Standard (0.001 mg/L)																					
		Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Nov	Feb	Apr	July
		1QM	2QM	3QM	4QM	5QM	6QM	7QM	8QM	9QM	10QM	11QM	12QM	13QM	14QM	15QM	16QM	17QM	18QM	19QM	20QM	21QM	21QM
1	Township near project site	<0.00015	<0.00015	<0.0005	<0.0005	<0.0005	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
2	Rajnagar	<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001
3	Kalekarber	<0.00015	<0.00015	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
4	Kapasdanga	<0.00015	<0.00015	<0.0005	<0.0005	<0.00015	0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	<0.00015	0.001	<0.0001	<0.001		<0.001	<0.001	<0.001	<0.001	0.001	<0.001

Source: CEGIS Field Survey

Note: 1QM= First Quarterly Monitoring, 2QM = Second Quarterly Monitoring, 3QM = Third Quarterly Monitoring, 4QM = Fourth Quarterly Monitoring: NS=Not Surveyed; NF=Non-functional; N/A=Not Availability; TC=temporarily closed, D=Damaged

\*Drinking water quality standards, The Environment Conservation Rules, 1997





## (C) Noise Level monitoring data

Table C.1: Ambient noise monitoring status at the monitored locations

SI No	Location	QM1 (Noise Level in dB (A)) Mar-14				QM2 (Noise Level in dB (A)) Jul-14				QM3 (Noise Level in dB (A)) Oct-14				QM4 (Noise Level in dB (A)) Jan-15				Std*
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time
1	Chalna, Dacope	80.32	60.86	63.22	68.13	52.71	55.62	50.27	52.87	53.37	53.52	57	54.63	51.92	53.7	54.21	53.28	70
2	NW Corner of the Project area	55.23	53	47.43	51.89	NM	NM	NM	NM	42.67	41.73	41.37	41.92	33.87	36.42	35.46	35.25	50
3	Chunkuri-2, Bajua	62.69	57.19	53.39	57.76	54.61	51.14	51.9	52.55	52.26	51.14	50.76	51.39	55.08	46.29	46.49	49.29	50
4	SW corner of the Project area	49.2	NM	NM	49.2	44.55	48.94	49.33	47.6	45.56	45.1	47.18	45.95	36.57	34.24	37.27	36.03	50
5	Proposed Township area, Project site	47.8	49.7	NM	48.75	46.15	47.21	NM	46.68	42.67	41.73	41.37	41.92	41.49	39.55	43.37	41.47	50
6	Barni, Gaurambha	64.95	50.93	60.65	58.84	48.73	50.37	50.75	49.95	50.18	50.89	48.27	49.78	43.36	38.56	48.86	43.6	50
7	Khan Jahan Ali Bridge, Khulna	76.12	66.72	72.25	71.7	55.97	64.68	61.75	60.8	72.24	58.3	68.3	66.28	61.34	63.4	60.41	61.72	70
8	Mongla Port area	69.38	54.55	59.79	61.24	54.75	54.2	52.58	53.84	66.8	55.2	59.5	60.5	40.26	35.04	40.76	38.69	75
9	Harbaria, Sundarbans	39.24	NM	42.51	40.88	59.25	60.52	48.62	56.13	54.08	56.51	NM	55.3	36.36	32.4	NM	34.38	45
10	Akram Point, Sundarbans	40.95	41.98	39.9	40.94	48.95	46.86	NM	47.9	45.27	42.69	NM	43.98	37.9	30.75	NM	34.32	45
11	Hiron Point, Sundarbans	35.99	40.75	39.16	38.63	51.29	NM	NM	51.29	47.98	39.42	NM	47.98	42.82	31.93	NM	37.37	45

Note(s): NM – Not Monitored, \*Std- Standard as defined in National Noise Control Rules 2006

Table C.2: Ambient noise monitoring status at the monitored locations

SI No	Location	QM 5 (Noise Level in dB (A)) Apr-15				QM 6 (Noise Level in dB (A)) Jul-15				QM 7 (Noise Level in dB (A)) Oct-15				QM 8 (Noise Level in dB (A)) Jan-16				Std*
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time
1	Chalna, Dacope	57.27	54.31	59.65	57.08	43.52	54.23	51.56	49.77	68.32	66.09	60.96	65.12	67.84	61.25	66.31	66.07	70
2	NW Corner of the Project area	45.05	42.15	46.8	44.67	37.58	40.91	46.18	41.56	41.51	39.58	44.74	41.94	53.91	49.02	49.95	50.96	50
3	Chunkuri-2, Bajua	45.9	48.19	NM	47.05	40.57	42.23	39.17	40.66	47.53	45.48	49.28	47.43	56.84	48.12	55.90	53.62	50
4	SW corner of the Project area	40.6	43.25	46.89	43.58	44.57	44.30	42.36	43.75	36.15	48.26	43.68	42.70	60.32	55.30	63.70	60.44	50
5	Proposed Township area, Project site	41.49	39.55	43.37	41.47	43.41	50.86	45.99	46.75	46.89	49.47	55.20	50.52	54.79	52.22	54.29	53.77	50
6	Barni, Gaurambha	58.23	50.11	NM	54.17	46.76	44.83	46.95	46.18	56.40	54.19	54.88	55.16	60.62	60.00	56.86	59.16	50
7	Khan Jahan Ali Bridge, Khulna	75.2	72.75	72.42	73.45	52.95	52.18	53.34	52.82	64.43	61.65	66.65	64.25	69.96	64.81	70.56	68.45	70
8	Mongla Port area	46.02	49.29	49.15	48.15	36.72	38.56	43.54	39.61	45.39	NM	48.63	47.01	54.15	51.82	52.14	52.70	75
9	Harbaria, Sundarbans	67.06	64.05	64.99	65.37	39.33	30.74	NM	35.03	54.97	46.54	NM	50.75	45.72	44.69	NM	45.20	45
10	Akram Point, Sundarbans	53.35	56.37	NM	54.86	NM	NM	NM	NM	45.28	53.92	NM	49.60	45.60	40.29	NM	42.95	45
11	Hiron Point, Sundarbans	47.48	48.2	NM	47.84	NM	NM	NM	NM	54.44	37.69	NM	46.06	NM	NM	NM	NM	45

Note(s): NM – Not Monitored, \*Std- Standard as defined in National Noise Control Rules 2006.

Table C.3: Ambient noise monitoring status at the monitored locations

SI No	Location	QM9 (Noise Level in dB (A)) Apr-16				QM 10 (Noise Level in dB (A)) Jul-16				QM 11 (Noise Level in dB (A)) Oct-16				QM 12 (Noise Level in dB (A)) Jan-17				Std*
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time
1	Chalna, Dacope	67.71	61.23	66.31	65.08	50.92	50.04	52.3	51.42	60.1	68.6	67.8	65.5	54.4	61	61.46	58.95	70
2	NW Corner of the Project area	53.81	48.66	49.90	50.79	54.40	53.19	50.36	52.65	54.7	54.8	57.0	55.5	44.52	44.52	NM	44.52	50
3	Chunkuri-2, Bajua	43.30	43.35	46.84	44.49	56.29	49.4	54.51	53.4	50.4	47.7	56.6	51.6	55.73	56.2	NM	55.31	50
4	SW corner of the Project area	56.81	54.73	51.97	54.50	67.38	74.12	54.61	65.37	47.8	49.0	50.8	49.2	44.41	45.96	NM	45.19	50
5	Proposed Township area, Project site	55.02	52.41	52.69	53.37	62.71	52.98	51.67	55.79	45.8	41.6	48.7	45.4	NM	43.4	41.85	42.63	50
6	Barni, Gaurambha	50.63	54.19	57.09	53.97	51.2	59.54	59.53	56.75	52.4	57.3	55.0	54.9	49.75	48.35	NM	49.05	50
7	Khan Jahan Ali Bridge, Khulna	66.40	64.82	66.34	65.85	63.52	62.15	65.73	63.80	61.9	59.6	61.3	60.9	51.69	60.05	54.97	55.57	70
8	Mongla Port area	49.89	48.67	51.07	49.88	53.87	52.04	52.7	52.87	49.5	50.0	50.2	49.9	47.82	48.67	50.33	48.94	75
9	Harbaria, Sundarbans	44.40	44.69	NM	44.55	53.87	53.04	52.79	52.9	57.2	53.5	49.3	53.3	41.13	38.4	37.98	39.17	45
10	Akram Point, Sundarbans	45.60	40.29	NM	42.95	47.16	46.48	50.24	47.96	40.5	43.0	42.5	42.0	38.74	38.45	37.06	38.08	45
11	Hiron Point, Sundarbans	48.53	37.69	NM	43.11	NM	NM	NM	NM	46.1	42.08	41.9	44.0	43.62	40.96	42.29	42.29	45

Note(s): NM – Not Monitored, \*Std- Standard as defined in National Noise Control Rules 2006.

Table C.4: Ambient noise monitoring status at the monitored locations

SI No	Location	QM13 (Noise Level in dB (A)) Apr-17				QM 14 (Noise Level in dB (A)) Oct-17				QM 15 (Noise Level in dB (A)) Jan-2018				QM 16 (Noise Level in dB (A)) April-2018				Std*
		Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A.noon (13:00)	Evening (18:00)	Day time AVG	Day time
1	Chalna, Dacope	58.21	59.00	66.57	61.62	47.65	51.06	50.27	49.66	60.2	60.2	60.5	60.3	64.09	59.30	65.43	62.94	70
2	NW Corner of the Project area	44.97	49.30	47.31	47.19	47.65	45.12	46.65	46.47	47.8	48.1	49.2	48.37	47.92	54.32	61.14	54.46	55
3	Chunkuri-2, Bajua	45.60	52.29	53.42	50.44	39.82	45.60	41.73	42.38	51.1	51.2	52.1	51.47	44.77	46	63.14	51.30333	55
4	SW corner of the Project area	39.62	42.64	47.48	43.25	60.80	64.08	62.52	62.47	43.5	43.5	45.7	44.23	64.45	63.49	66.63	64.85667	55
5	Project site near Shapmari area	41.40	43.09	43.45	42.65	43.05	48.52	45.01	45.53	53.2	54	52.82	53.34	51.95	59.66	56.8	56.13667	55
6	Barni, Gaurambha	43.05	46.45	45.01	44.83	45.60	52.29	53.42	50.44	56.5	54.2	56.1	55.6	55.6	51.80	51.39	52.93	60
7	Khan Jahan Ali Bridge, Khulna	54.01	57.50	58.66	56.72	40.60	42.64	46.55	43.26	60.2	62.1	62.2	61.5	49.4	45.25	47.98	47.54333	70
8	Mongla Port area	47.78	47.45	45.25	47.61	41.40	44.68	45.71	43.93	60.2	60.2	58.4	59.6	50.84	48.33	53.25	50.80667	75
9	Harbaria, Sundarbans	50.79	53.67	57.84	54.10	44.25	46.67	47.31	46.08	45.8	44.7	43.8	44.7	50.23	45.55	65.43	53.73667	50
10	Akram Point, Sundarbans	43.41	45.60	43.89	44.30	58.21	58.59	58.70	58.50	39.4	40.5	41.1	40.3	58.31	60.93	64.87	61.37	50
11	Hiron Point, Sundarbans	NM	NM	NM	NM	39.92	39.79	33.5	37.74	37.2	39	38.4	38.2					50

Source: CEGIS field Survey

Note: NM-Not measured.



Table C.5 Ambient noise monitoring status at the monitored locations

SI No	Location	QM 17 (Noise Level in dB (A)) July-2018				QM 18 (Noise Level in dB (A)) Nov-2018				QM 19 (Noise Level in dB (A)) Feb-2019				QM 20 (Noise Level in dB (A)) Apr-2019				Std*
		Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Day time
1	Chalna, Dacope	57.64	56.94	58.03	57.54	61.3	56.3	57.1	70	56.14	59.28	53.95	56.45	62.02	61.91	61.08	61.67	70
2	NW Corner of the Project area	42.80	47.51	46.57	45.63	56.5	60.1	59.85	55	45.15	54.11	53	50.75	53.70	58.92	57.92	56.85	55
3	Chunkuri-2, Bajua	46.23	49.02	47.34	47.53	45.8	48.9	51.3	55	50.19	49.35	51	50.18	49.66	54.02	51.35	51.68	55
4	SW corner of the Project area	58.84	48.00	51.03	52.63	64.5	60.6	60.2	55	53.50	58.01	55.88	55.79	58.08	54.79	55.27	56.05	55
5	Project site near Shapmari area	42.66	45.82	48.78	45.75	45.1	51.2	55.8	55	58.48	61.21	54.70	58.13	61.35	58.97	56.16	58.83	55
6	Barni, Gaurambha	42.67	47.95	45.90	45.51	58.3	50.6	50.2	60	54.32	57.65	45.75	52.57	58.58	51.05	49.92	53.18	60
7	Khan Jahan Ali Bridge, Khulna	64.1	64.06	61.90	63.35	64.6	60.9	60.9	70	65.72	69.04	66.03	66.93	67.95	63.09	69.82	66.95	70
8	Mongla Port area	63.12	59.00	60.77	60.96	55.8	53.1	59.0	75	64.33	63.37	70.85	66.18	64.12	62.41	65.45	63.99	75
9	Harbaria, Sundarbans	51.98	48.58	50.28	50.28	49.9	47.6	NM	50	51.43	47.90	NM	49.67	49.42	47.45	NM	48.43	50
10	Akram Point, Sundarbans	46.52	43.88	45.2	45.20	41.9	40.1	NM	50	47.35	45.55	NM	46.45	46.16	38.49	NM	42.33	50
11	Hiron Point, Sundarbans	NM	NM	NM	57.54	39.7	39.1	NM	50	33.8	44.62	NM	39.21	NM	NM	NM	-	50

Source: CEGIS field Survey

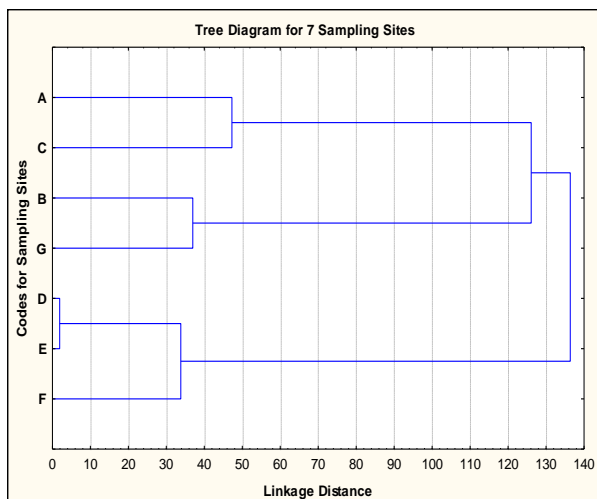
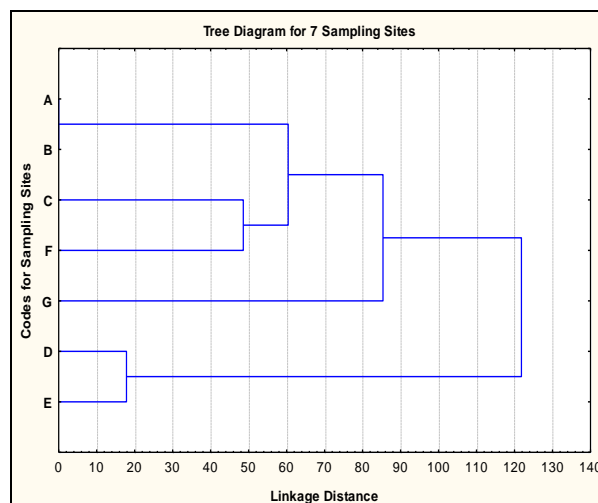
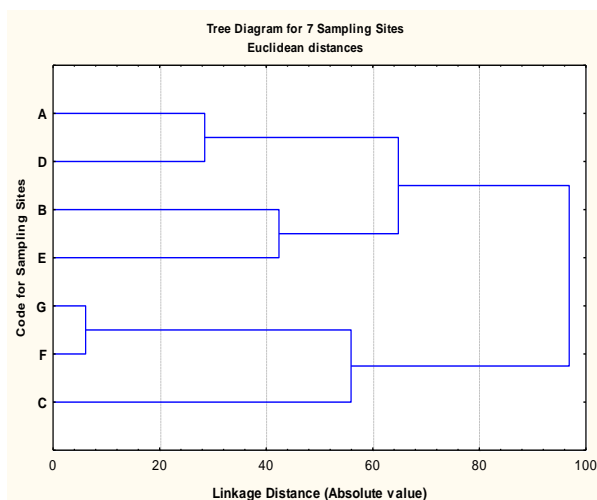
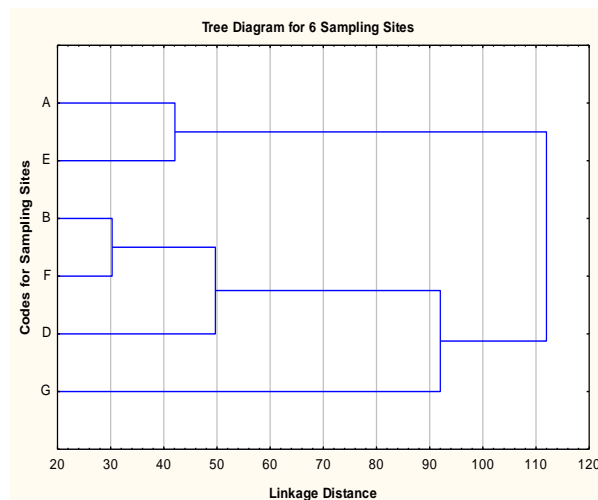
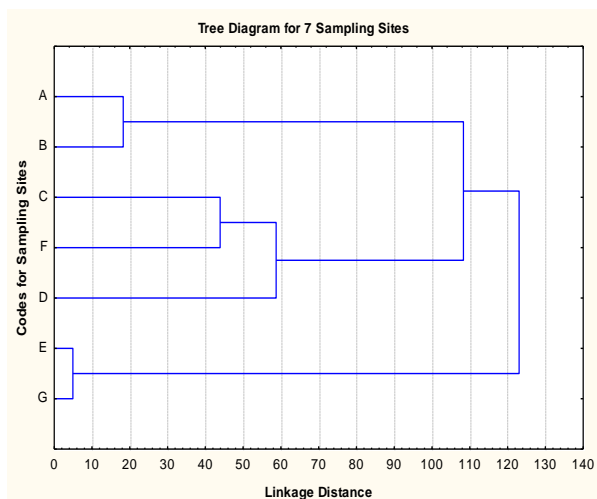
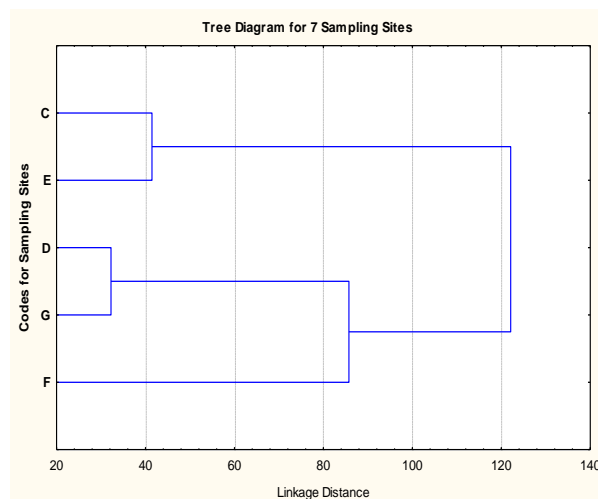
Note: NM-Not measured.

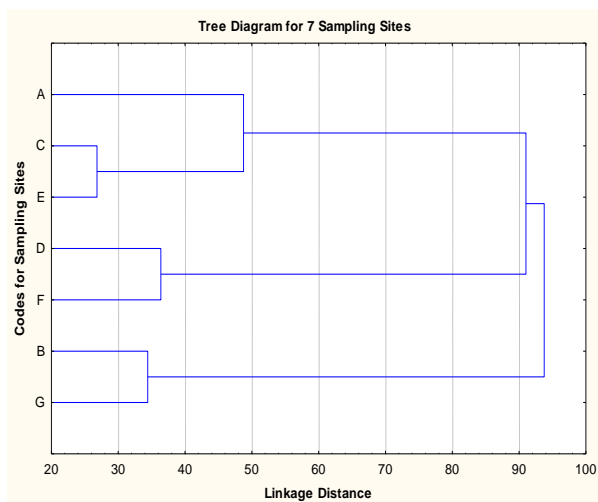
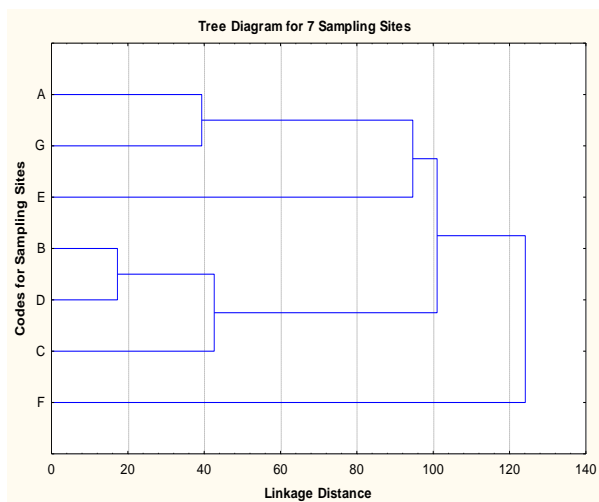
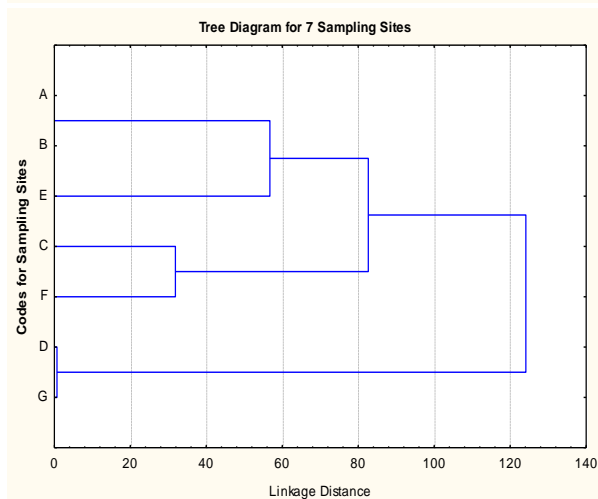
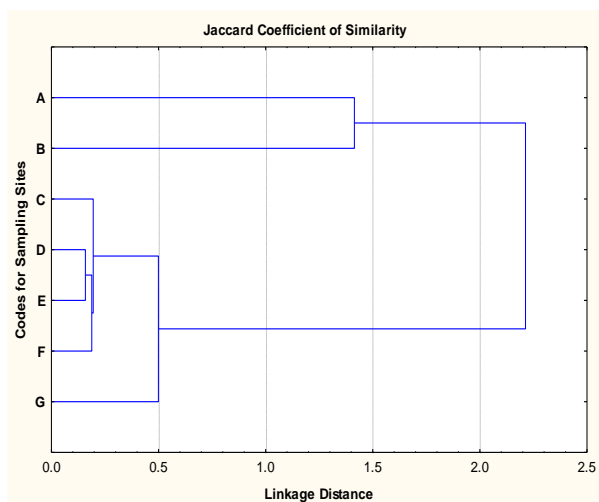
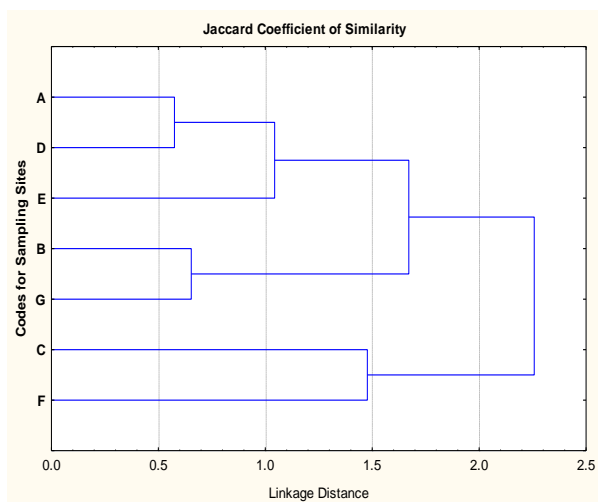
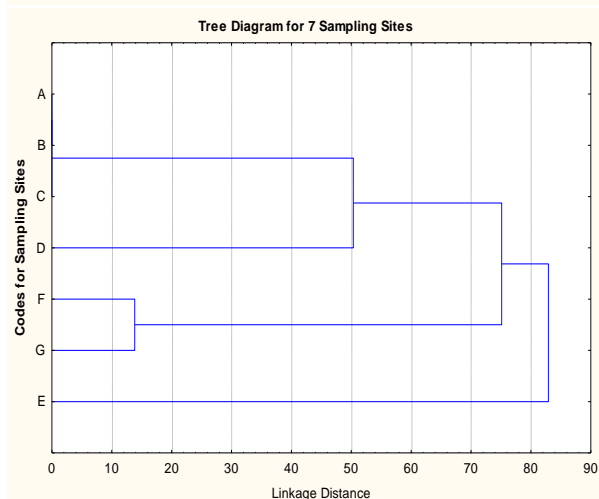
Table C.6 Ambient noise monitoring status at the monitored locations

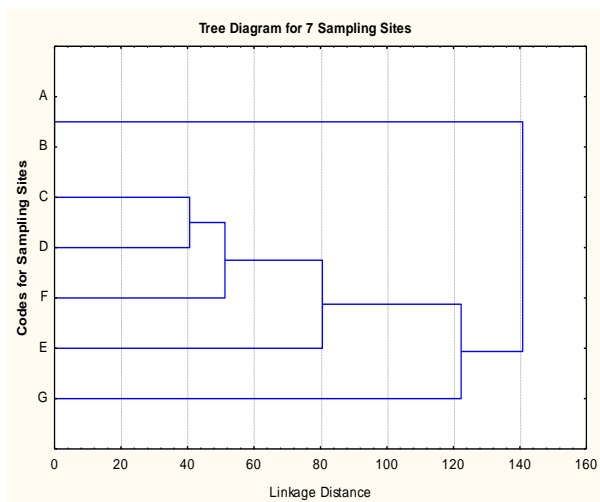
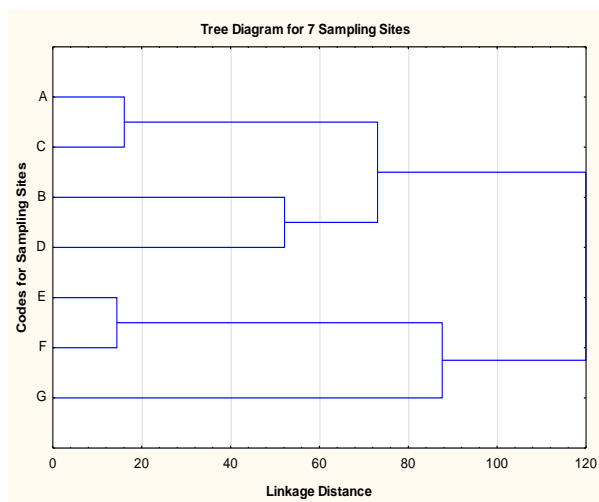
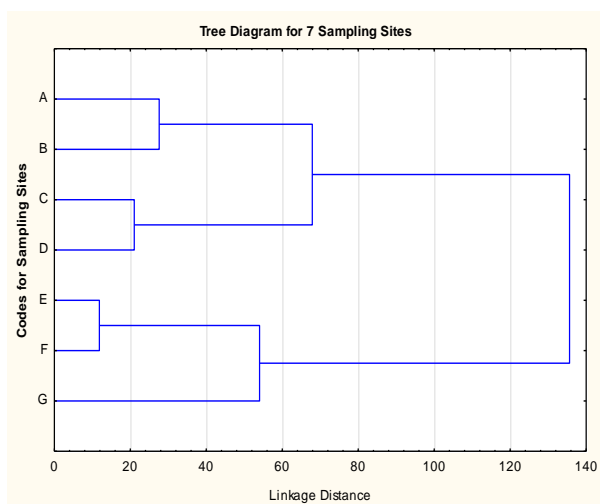
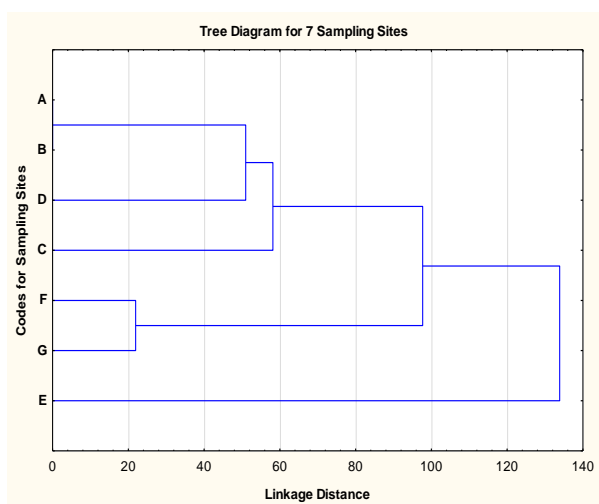
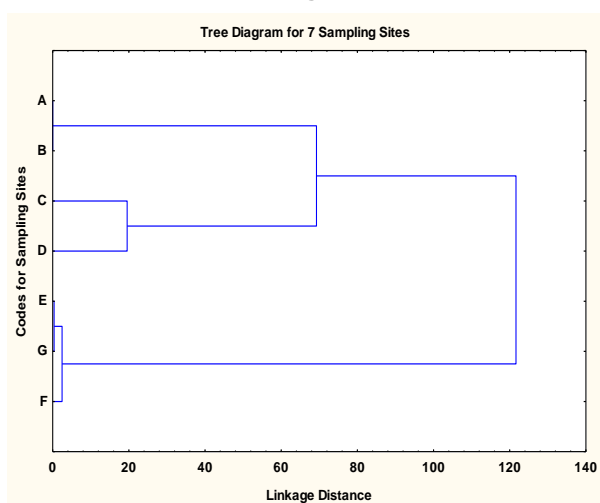
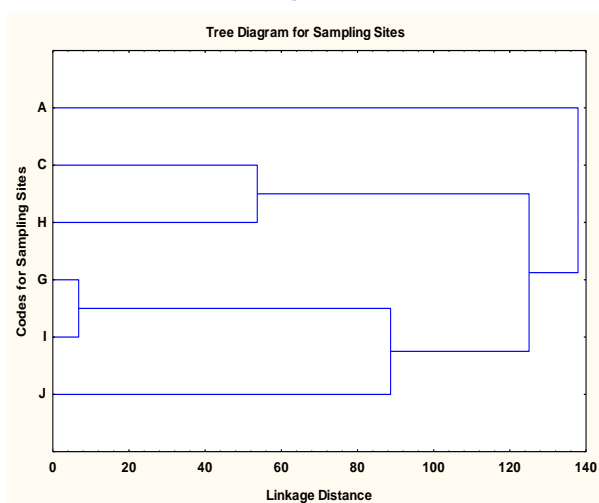
SI No	Location	QM 21 (Noise Level in dB (A)) July-2019				QM 22 (Noise Level in dB (A)) November-2019			
		Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG	Morning (9:00)	A. noon (13:00)	Evening (18:00)	Day time AVG
1	Chalna, Dacope	55.92	60.88	61.23	59.34	58.98	61.03	55.78	58.60
2	NW Corner of the Project area	56.44	53.21	55.88	55.18	48.92	53.45	50.97	51.11
3	Chunkuri-2, Bajua	56.15	63.34	58.60	59.36	58.39	52.92	54.51	55.27
4	SW corner of the Project area	66.94	58.41	65.65	63.66	47.67	49.98	42.05	46.57
5	Project site near Shapmari area	53.14	55.40	55.05	54.53	53.97	55.80	54.77	54.86
6	Barni, Gaurambha	51.36	57.98	NM	54.67	53.69	49.37	48.53	50.53
7	Khan Jahan Ali Bridge, Khulna	63.38	60.55	66.44	63.46	65.19	67.65	65.32	66.05
8	Mongla Port area	60.49	62.10	63.43	62.01	60.24	55.66	55.85	57.25
9	Harbaria, Sundarbans	47.62	42.18	NM	44.90	43.48	44.71	NM	44.10
10	Akram Point, Sundarbans	44.05	45.62	NM	44.84	47.12	42.60	NM	44.86
11	Hiron Point, Sundarbans	NM	NM	NM	-	39.2	41.34	NM	40.28

Source: CEGIS field Survey

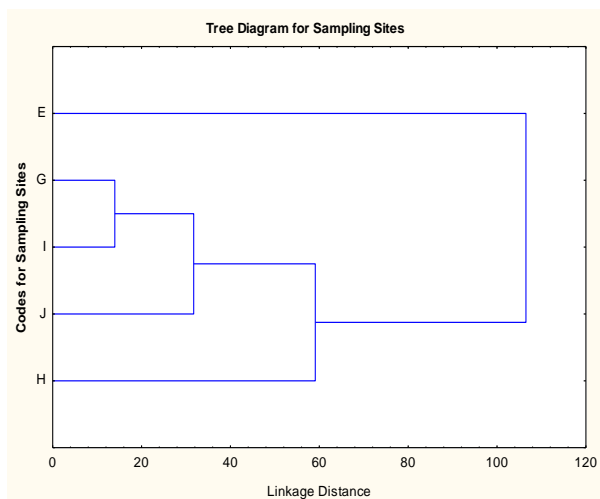
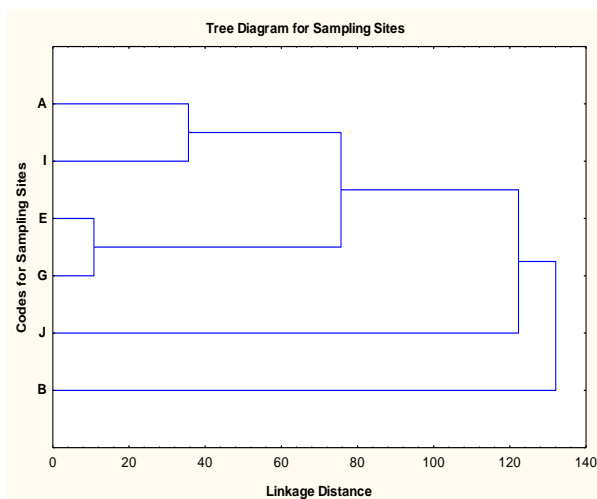
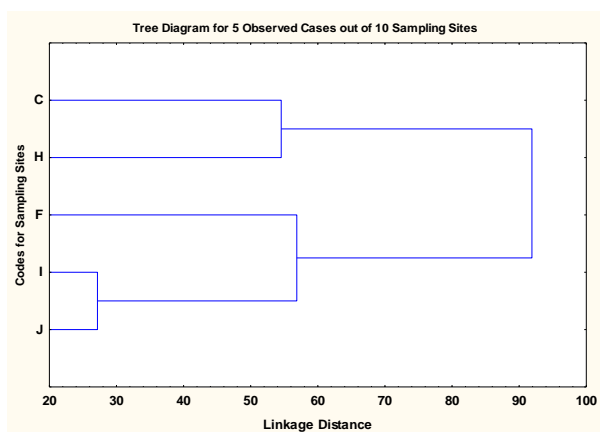
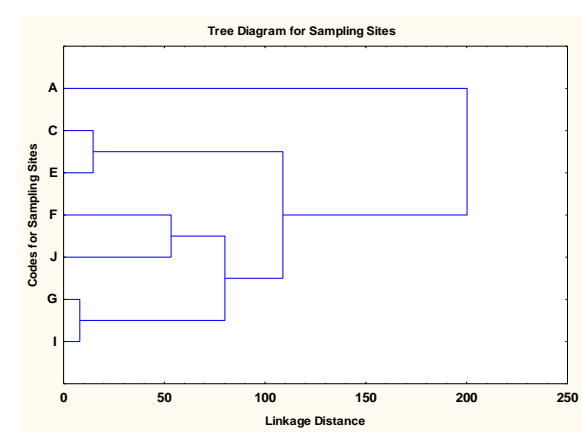
Note: NM-Not measured.

**(D) Fisheries resources monitoring data****Classification of functional habitat****1<sup>st</sup> Monitoring, April, 2014****2<sup>nd</sup> Monitoring, July 2014****3<sup>rd</sup> Monitoring, October, 2014****4<sup>th</sup> Monitoring, January 2015****5<sup>th</sup> Monitoring, April, 2015****6<sup>th</sup> Monitoring, August, 2015**

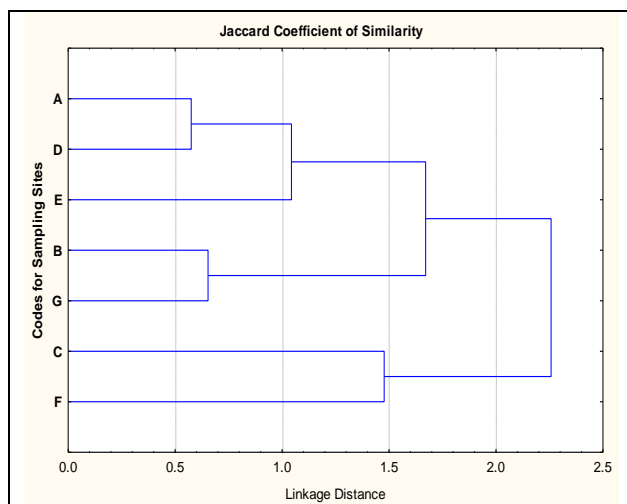
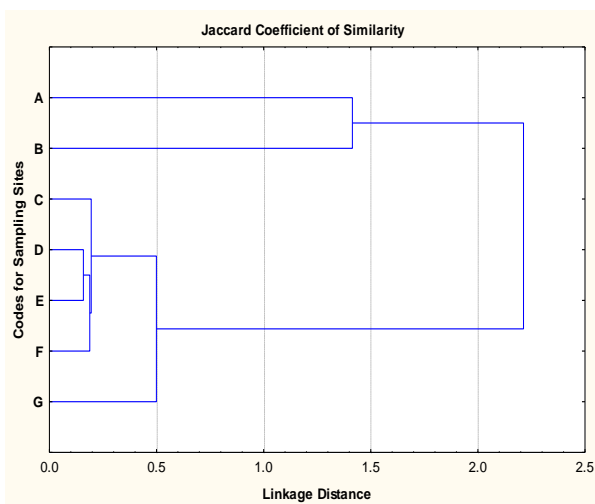
7<sup>th</sup> Monitoring, October, 20158<sup>th</sup> Monitoring, January, 20169<sup>th</sup> Monitoring, April, 201610<sup>th</sup> Monitoring, July, 2016

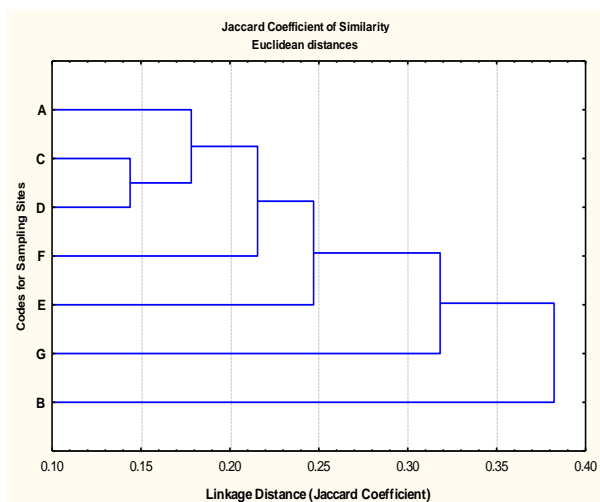
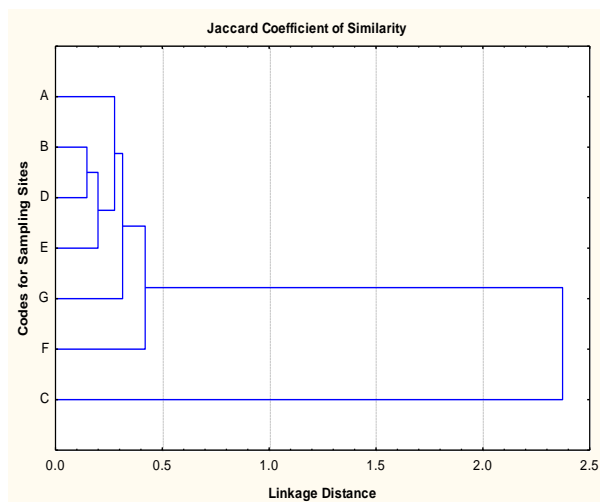
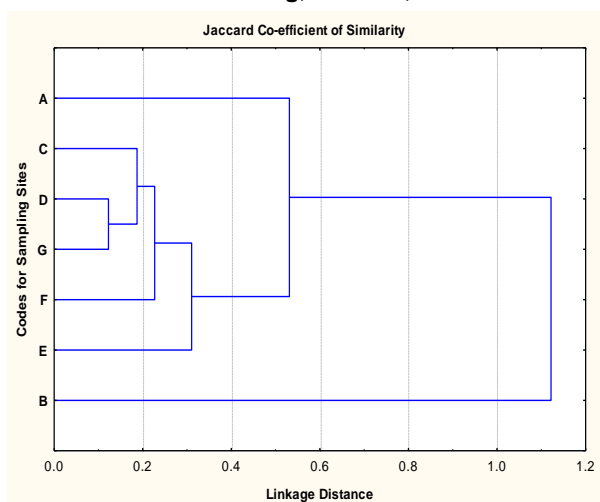
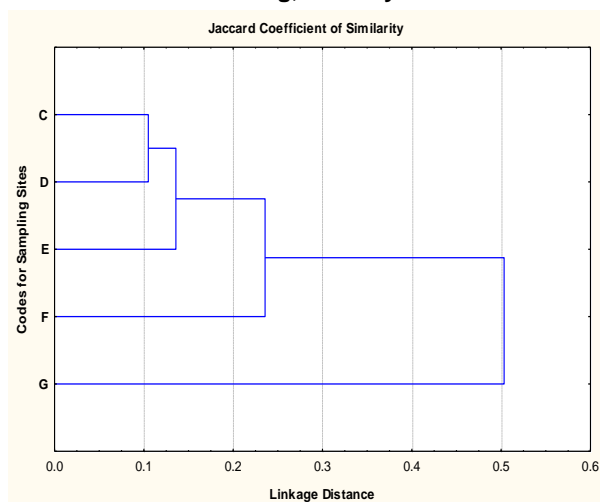
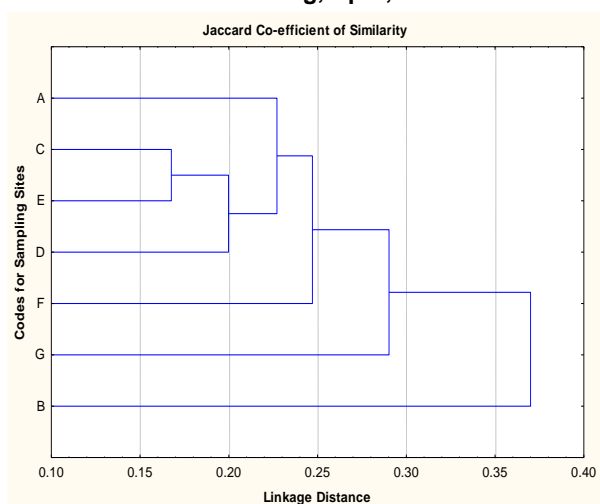
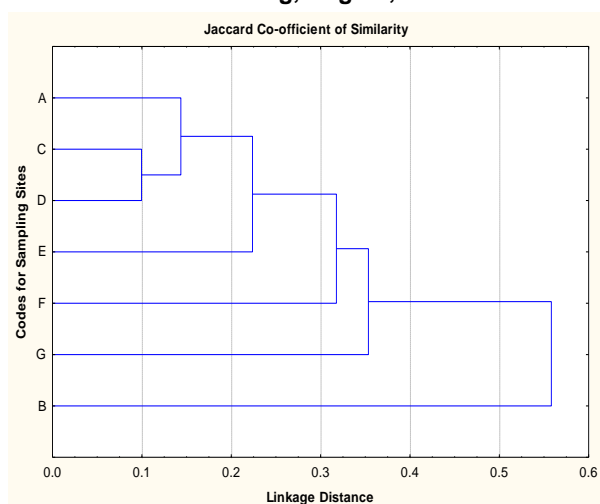
11<sup>th</sup> Monitoring, October, 201612<sup>th</sup> Monitoring, January, 201713<sup>th</sup> Monitoring, April, 201714<sup>th</sup> Monitoring, October, 201715<sup>th</sup> Monitoring, January, 201816<sup>th</sup> Monitoring, April, 2018

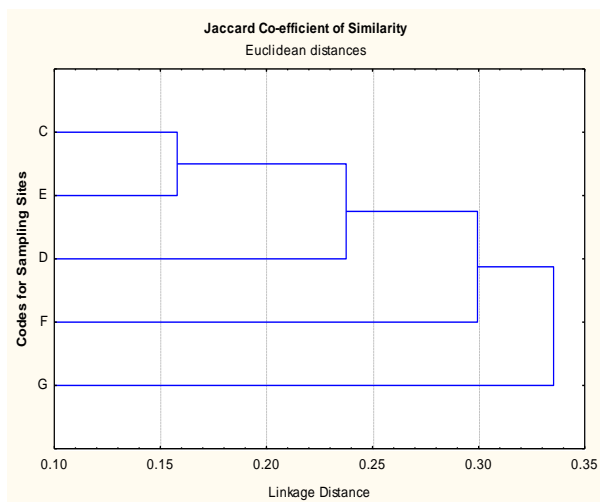
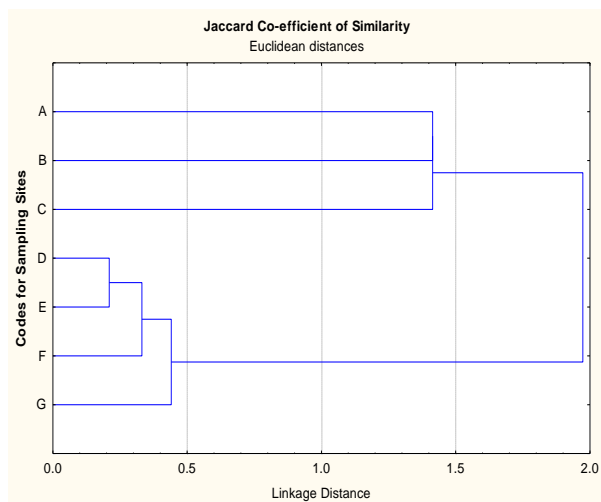
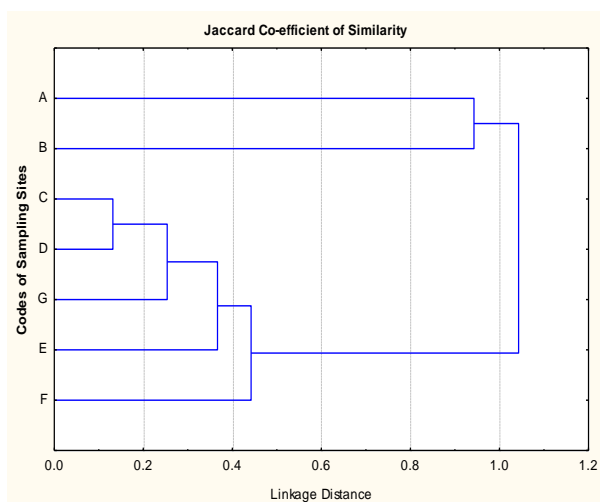
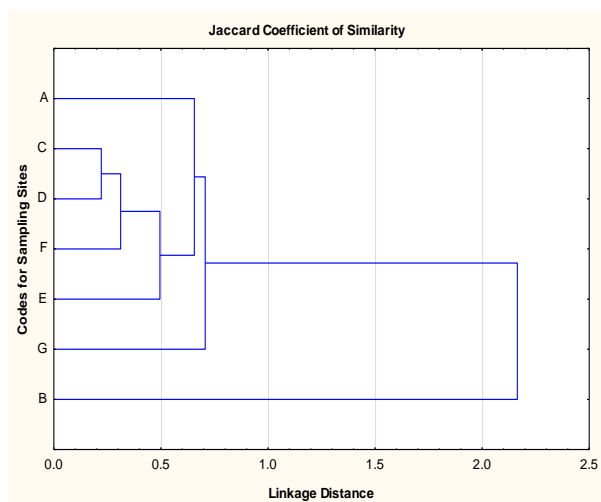
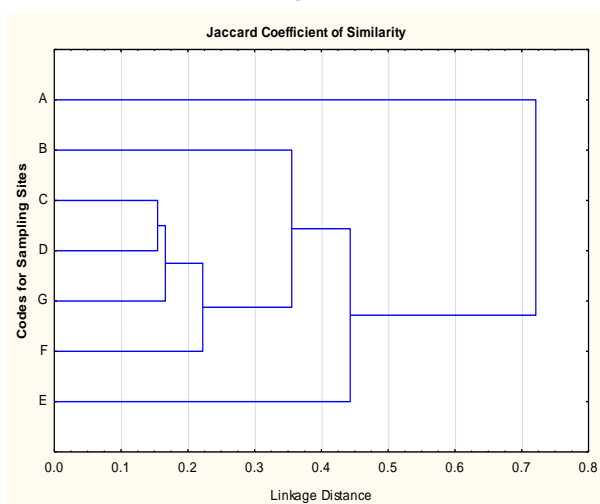
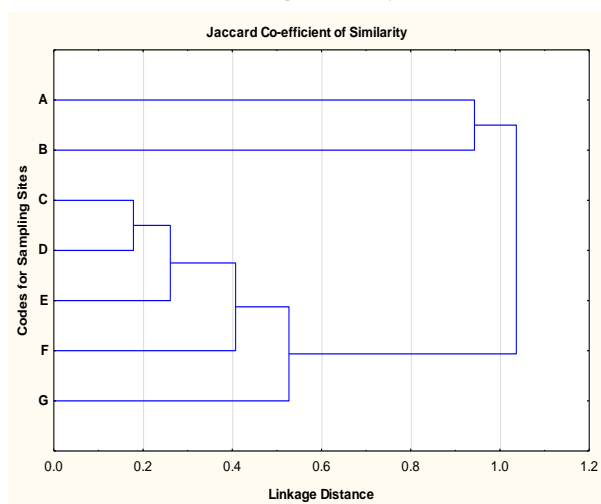


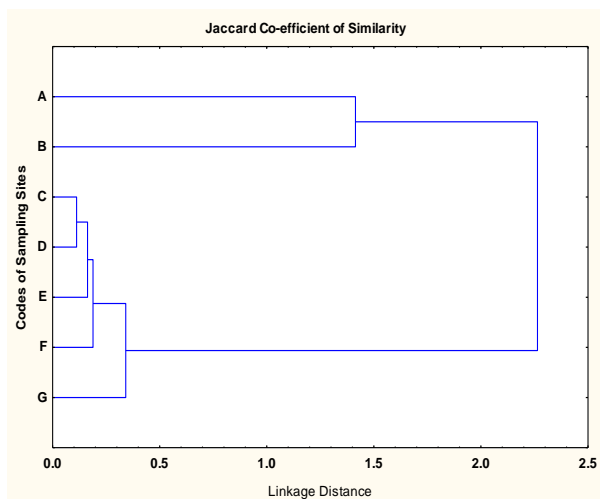
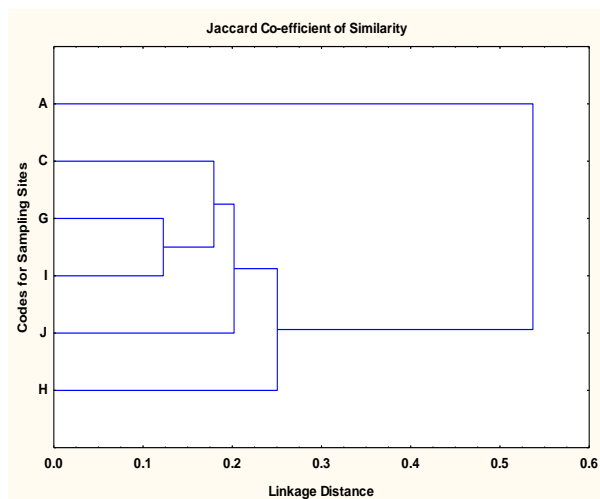
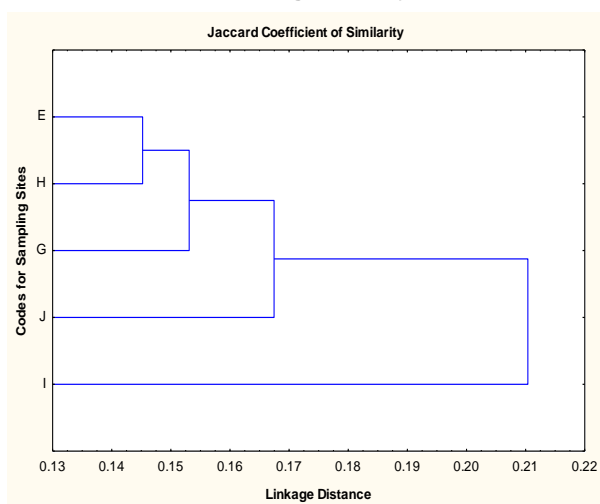
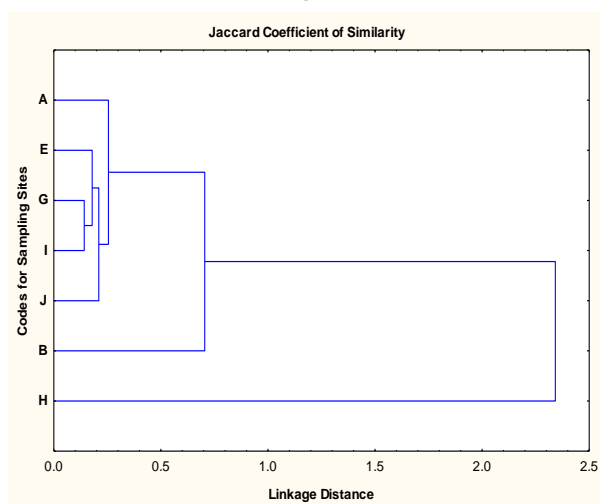
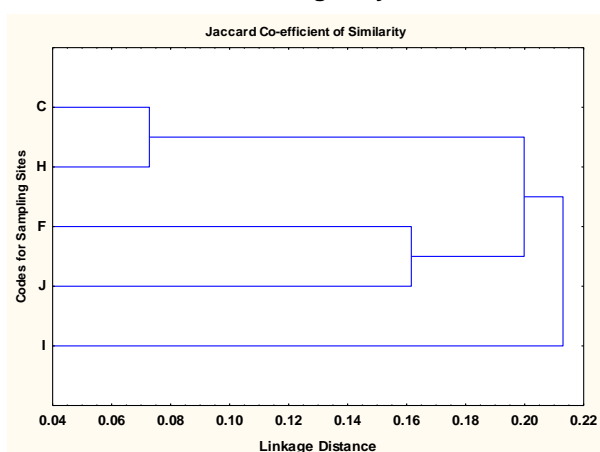
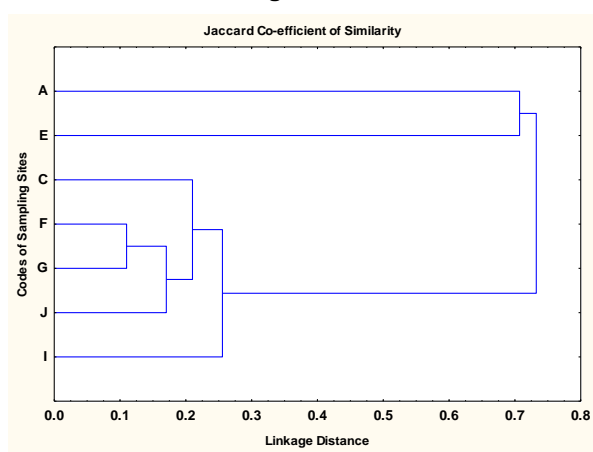
17<sup>th</sup> Monitoring, July, 201818<sup>th</sup> Monitoring, November, 201819<sup>th</sup> Monitoring, February, 201920<sup>th</sup> Monitoring, April, 2019

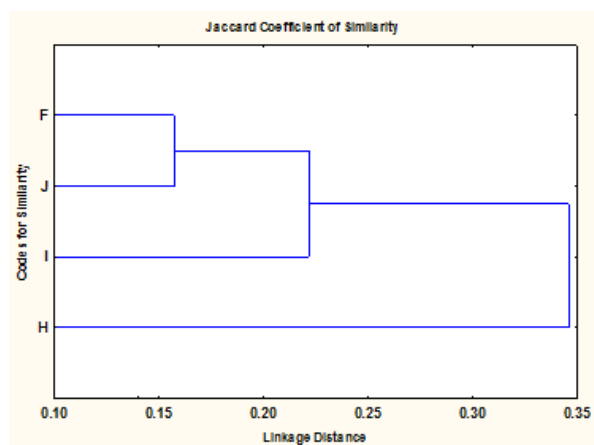
**Figure 2: Jaccard Co-efficient of Similarity of Habitats respecting fish species occurrence**

1<sup>st</sup> Monitoring, April, 20142<sup>nd</sup> Monitoring, July, 2014

**3<sup>rd</sup> Monitoring, October, 2014****4<sup>th</sup> Monitoring, January, 2015****5<sup>th</sup> Monitoring, April, 2015****6<sup>th</sup> Monitoring, August, 2015****7<sup>th</sup> Monitoring, October, 2015****8<sup>th</sup> Monitoring, January, 2016**

9<sup>th</sup> Monitoring, April, 201610<sup>th</sup> Monitoring, July, 201611<sup>th</sup> Monitoring, October, 201612<sup>th</sup> Monitoring, January, 201713<sup>th</sup> Monitoring, April, 201714<sup>th</sup> Monitoring, October, 2017

15<sup>th</sup> Monitoring, January, 201816<sup>th</sup> Monitoring, April, 201817<sup>th</sup> Monitoring, July, 201818<sup>th</sup> Monitoring, November, 201819<sup>th</sup> Monitoring, February, 201920<sup>th</sup> Monitoring, April, 2019



21<sup>st</sup> Monitoring, July 2019



Table D.2: Different Fish Species in different quarter monitoring

Rupchanda in 1<sup>st</sup> Quarter of 1<sup>st</sup> YearChela in 2<sup>nd</sup> Quarter of 1<sup>st</sup> Year

Phesa, Chela, Hilsa, Gagla Tengra



Harina Chingri

Fish Species at 3<sup>rd</sup> Quarter Monitoring of 1<sup>st</sup> Year 2014-15

Amadi Chela



Banspata

## Fish Species in Upstream of Passur River at 4th Quarter Monitoring of 1st Year 2014-15



Adult Poma in Chalna Point



Fry of Bagda at Chalna Point



Meth and Gagra Tengra



Gagra Tengra

**Fish species found in 1<sup>st</sup> quarter of the second monitoring year (2015-16)**



Mutkure and Paissa



Khorsula



Menu



Vetki

**Fish species found in 2<sup>nd</sup> quarter of the second monitoring year (2015-16)**





**Gulsha Tengra, Bele, Aswine Bele and Paissa**



**Gangania**



**Telcupa**



**Golda**



**Kain Magur**



**A Mix of Culture and Capture Fishes**

**Fish species found in 3<sup>rd</sup> quarter of the second monitoring year (2015-16)**



**Tau Paissa**



**Bele**



**Horina Chingri**



**Gulsha and Gagra Tengra**



**Jaba**



**Female Gulsha Tengra**



**Fry Fishes**



**Chata Bele**

**Fish species found in 4<sup>th</sup> quarter of the second monitoring year (2015-16)**



**Kain Magur**



**Banspata, Vetki, Koidda and Poma**



**Fish species found in 1<sup>st</sup> quarter of the 3<sup>rd</sup> monitoring year (2016-17)****Poma and Tapsi****Tapsi****Fish species found in 2<sup>nd</sup> quarter of the 3<sup>rd</sup> monitoring year (2016-17)****Miscellaneous Fish Species****Hilsha****Tapse****Poma and Tapse****Fish species found in 3<sup>rd</sup> quarter of the 3<sup>rd</sup> monitoring year (2016-17)**





**Catch Sample**



**Juvenile of Kain Magur**



**Khayra Chela**



**Jevenile of Pangas**



**Brood Paissa**



**Paissa and Gagra Tengra**



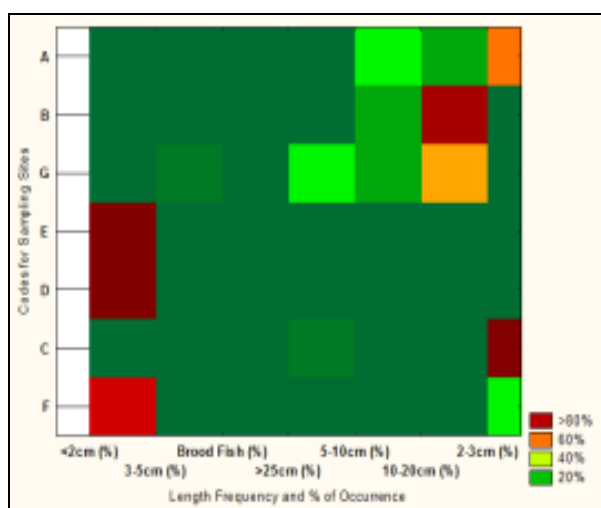
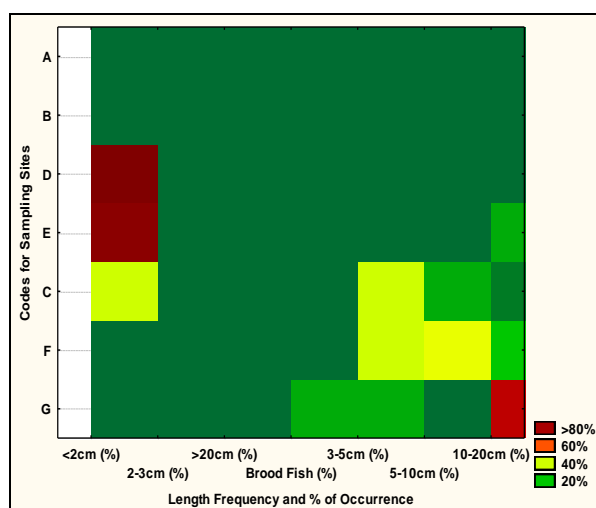
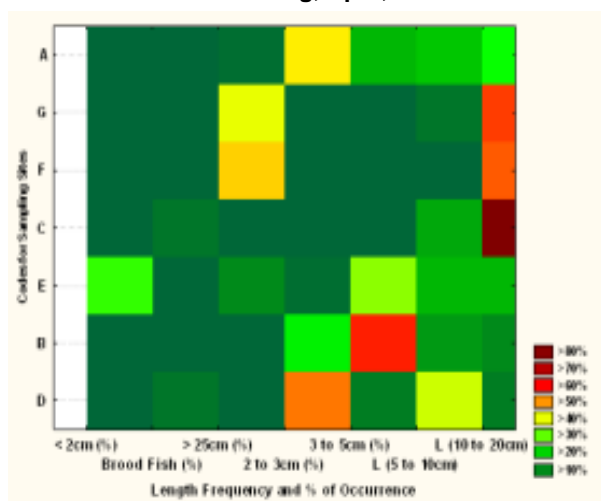
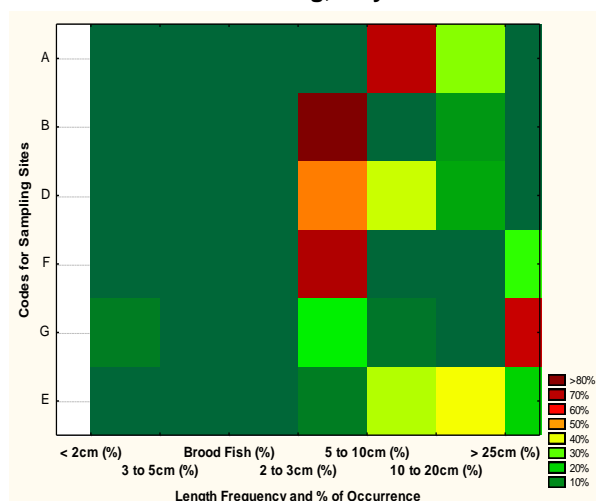
Aswene Bele, Daitna, Tapse and Chitra

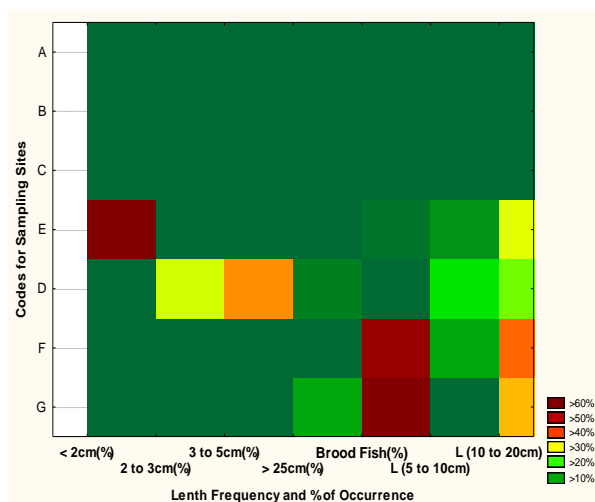
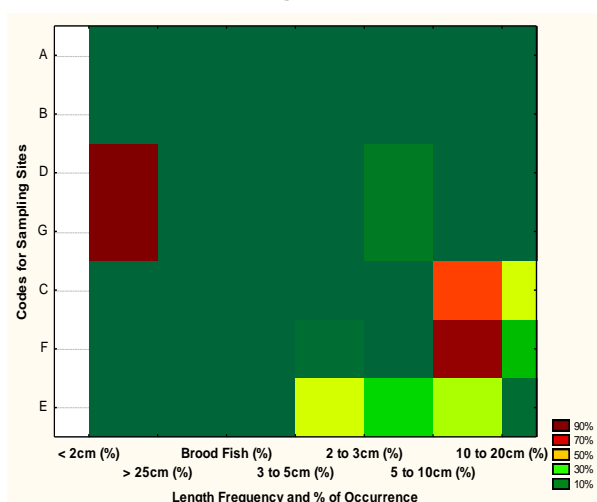
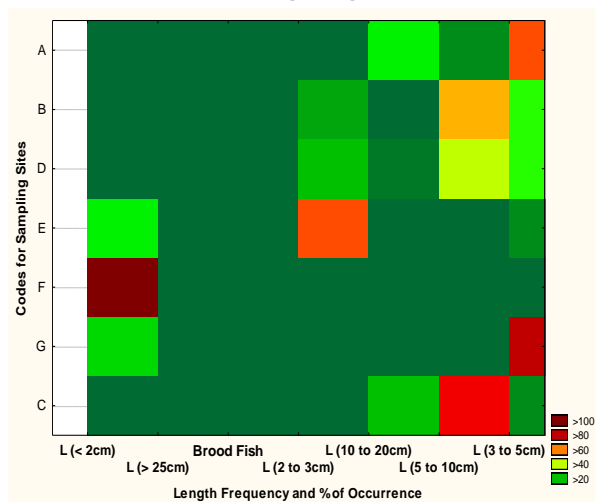
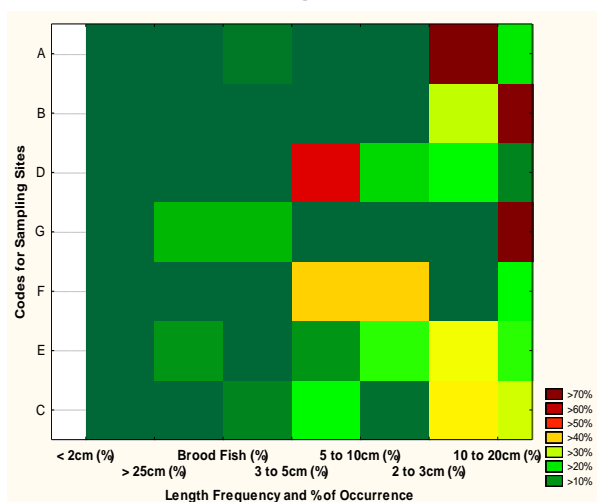
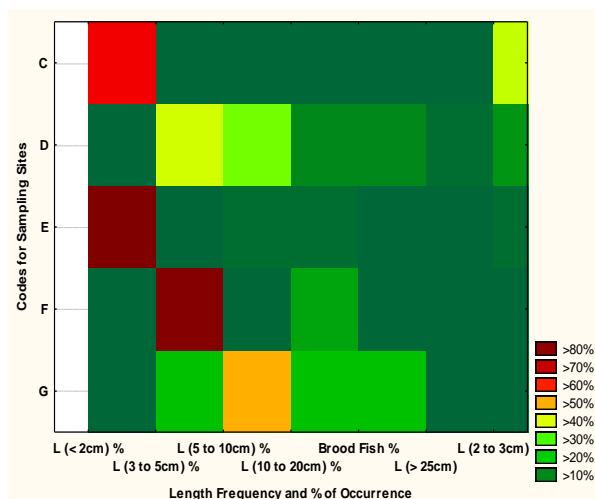
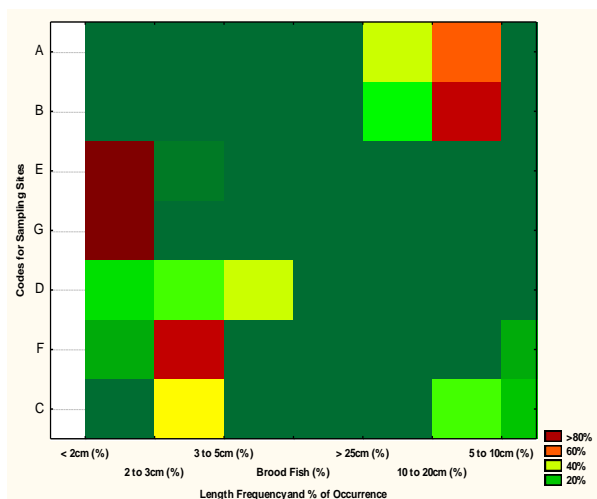


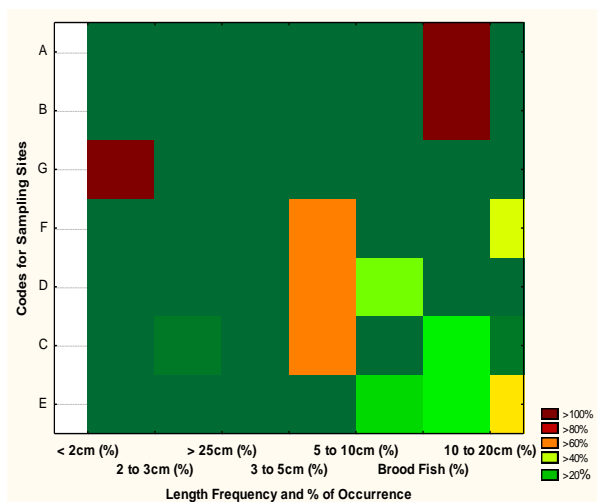
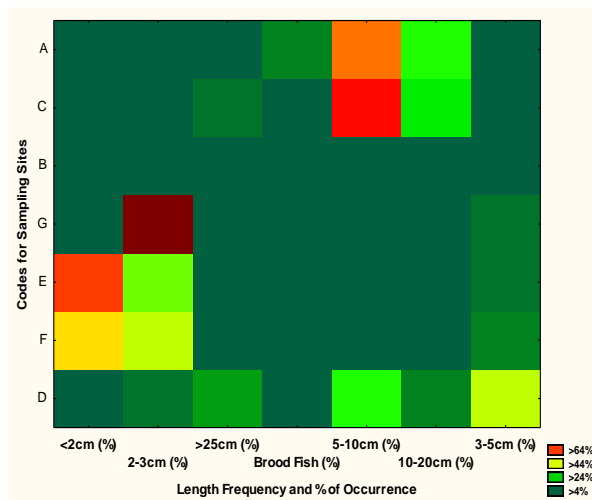
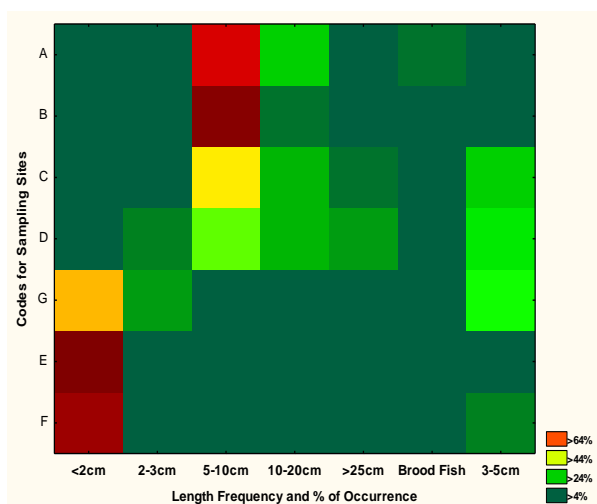
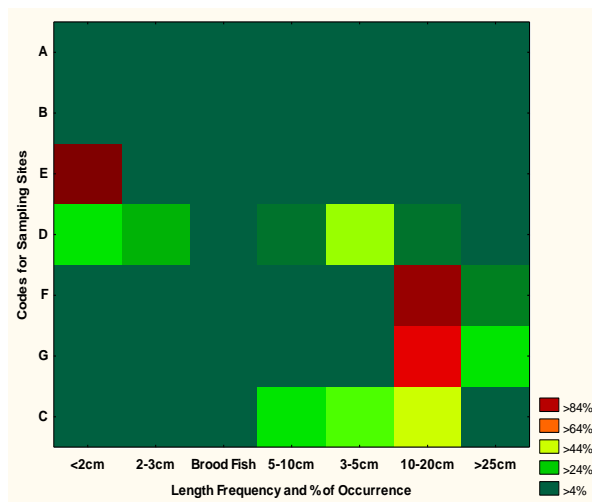
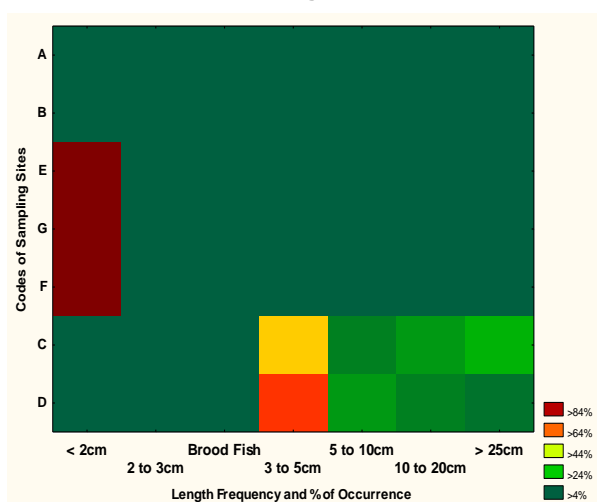
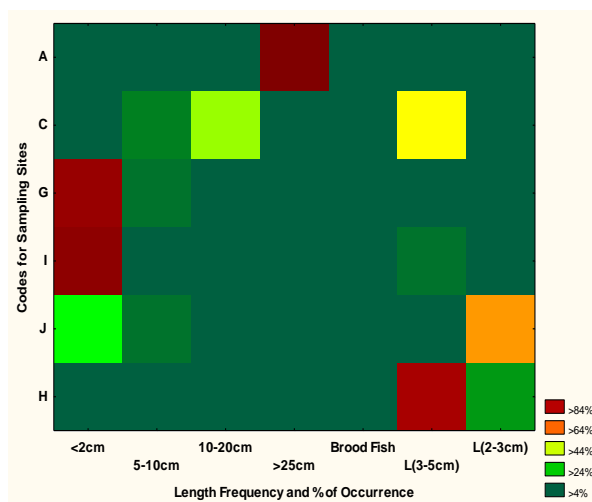
Dry Fish of Khayra Chela

### Fish species found in 12<sup>th</sup> quarter of the monitoring year 2016-17

#### Fish Community Structure

1<sup>st</sup> Monitoring, April, 20142<sup>nd</sup> Monitoring, July, 20143<sup>rd</sup> Monitoring, October, 20144<sup>th</sup> Monitoring, January, 2015



11<sup>th</sup> Monitoring, October, 201612<sup>th</sup> Monitoring, January, 201713<sup>th</sup> Monitoring, April, 201714<sup>th</sup> Monitoring, October, 201715<sup>th</sup> Monitoring, January, 201816<sup>th</sup> Monitoring, April, 2018

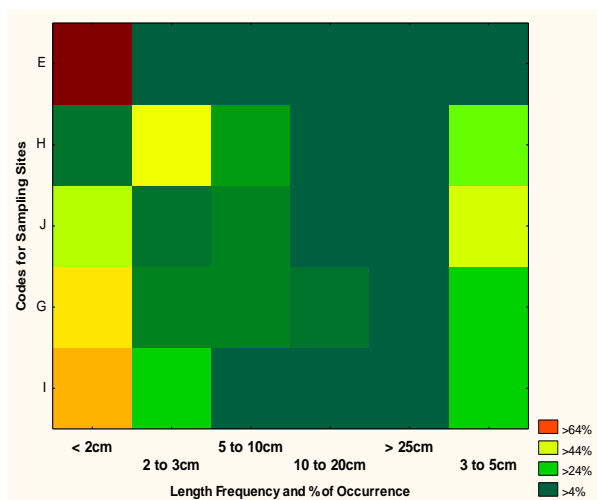
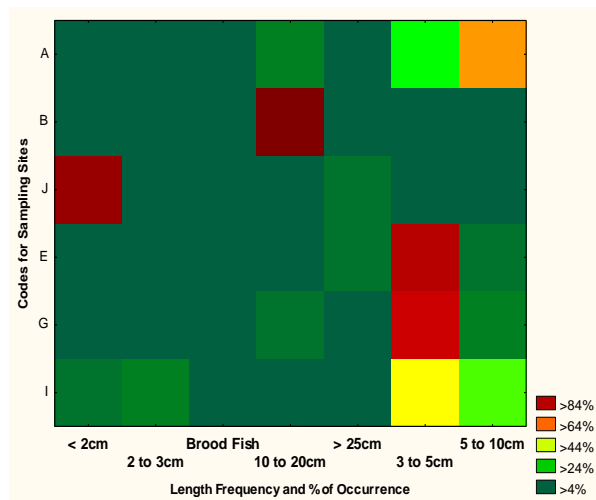
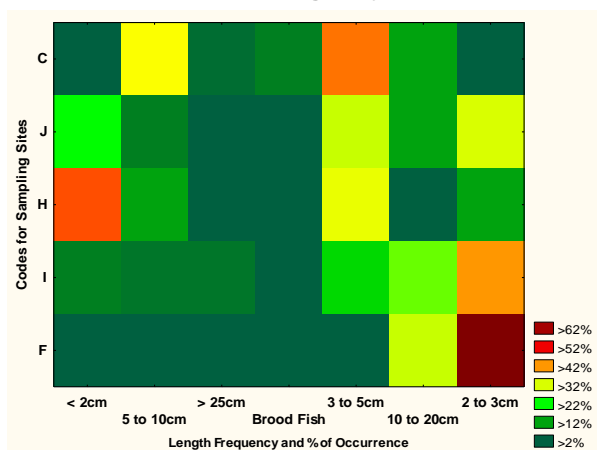
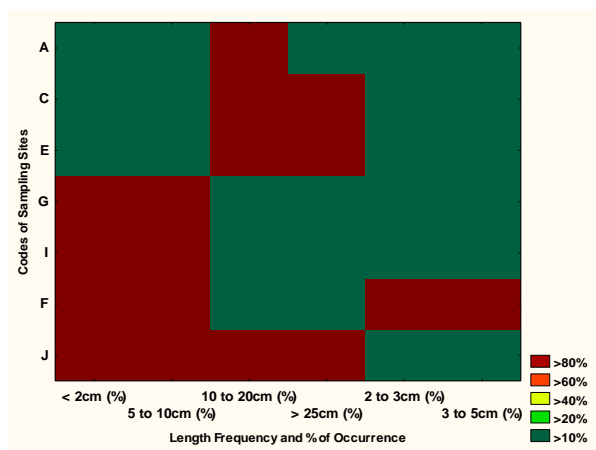
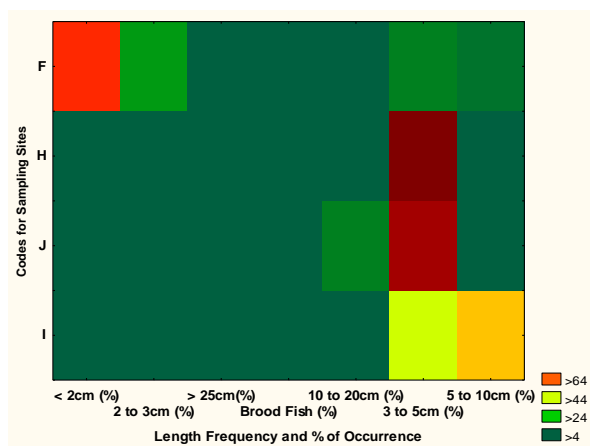
17<sup>th</sup> Monitoring, July, 201818<sup>th</sup> Monitoring, November, 201819<sup>th</sup> Monitoring, February, 201920<sup>th</sup> Monitoring, April, 201921<sup>st</sup> Monitoring, July 2019



Table D.2: Occurrence of Species (1<sup>st</sup> to 12<sup>th</sup> QM)

Local Name	Scientific Name	Local Status*	1st QM	2nd QM	3rd QM	4th QM	5th QM	6th QM	7th QM	8th QM	9th QM	10th QM	11th QM	12th QM
			‘-’ = No; ‘+’ = Occurrence											
Hilsa	<i>Tenualosa ilisha</i>	NO	-	-	+	-	-	+	+	-	-	-	+	-
Sagor Baim	<i>Anguilla bengalensis</i>	NT	+	-	-	-	-	+	-	-	-	-	-	-
Bacha	<i>Eutropiichthys vacha</i>	CR	+	-	-	-	-	-	-	-	-	+	-	-
Bagda Chingri	<i>Penaeus monodon</i>	DD	+	+	+	+	+	+	+	+	+	+	-	+
Banspata	<i>Brachypleura novae-zeelandiae</i>	NO	+	+	+	+	-	+	+	+	+	-	+	+
Kukurjib	<i>Cynoglossus lingua</i>	NO	+	-	-	-	-	-	-	+	+	+	-	+
Bele	<i>Glossogobius giuris</i>	NO	+	+	+	+	+	+	+	+	+	-	+	+
Aswine Bele	<i>Butis butis</i>	NO	-	-	-	-	-	-	+	+	+	+	+	+
Bairagi	<i>Coilia dussumieri</i>	NO	+	+	+	+	+	+	-	+	-	-	-	+
Boishakhi Chingri	<i>Macrobrachium</i> sp.	NO	-	+	-	-	+	+	+	+	+	-	-	-
Chammu Chingri	<i>Metapenaeus brevicornis</i>	DD	+	+	+	-	+	+	+	+	+	+	+	-
Chaka Chingri	<i>Penaeus indicus</i>	DD	+	+	-	+	+	+	+	+	+	-	+	-
Ghora Chela	<i>Securicula gora</i>	-	+	-	-	-	-	-	-	-	-	-	-	-
Chanda Chela	<i>Securicula</i> sp.		-	+	+	-	-	-	-	-	+	+	-	-
Sada Chewa	<i>Trepauchen vagina</i>	NO	+	-	+	-	-	+	-	-	-	+	-	-
Lal Chewa	<i>Taenioides cirratus</i>	NO	+	+	+	+	+	+	+	+	+	-	-	-
Chhuri	<i>Trichiurus muticus</i>	NO	+	-	+	-	-	-	-	-	-	-	-	-
Sagor Chela	<i>Megalops cyprinoids</i>	NO	+	-	-	-	-	-	-	-	-	-	-	-
Purabi Chela	<i>Thyrssa purava</i>	NO	+	-	-	-	-	-	-	-	-	-	-	-
Kabashi Tengra	<i>Mystus cavasius</i>	DD	+	-	-	-	-	-	-	-	-	-	-	-
Gagra Tengra	<i>Nemapteryx nenga</i>	DD	-	+	+	-	+	-	+	-	+	+	+	+
Gulsha Tengra	<i>Mystus bleekery</i>	DD	+	+	-	+	-	+	+	+	+	+	+	+
Harina Chingri	<i>Metapenaeus ensis</i>	DD	+	+	+	+	+	+	+	+	+	-	+	-
Ekthuto	<i>Hyporhamphus limbatus</i>	NO	+	-	+	+	-	-	-	+	+	-	+	-
Kakila	<i>Xenentodon cancila</i>	NO	+	-	-	-	-	-	-	-	-	-	+	-
Chapila	<i>Gudusia chapra</i>	NO	+	+	-	-	-	-	-	-	-	+	-	-
Kuchia	<i>Monopterusuchia</i>	DD	+	+	-	+	+	+	+	+	+	+	+	+
Loitta	<i>Harpodon nehereus</i>	NO	+	+	+	-	+	-	-	-	+	+	-	-
Motka Chingri	<i>Macrobrachium villosimanusless</i>	DD	+	+	+	+	+	+	+	+	+	+	+	-
Mud Crab	<i>Scylla serrata</i>	NO	+	-	+	+	+	+	+	+	+	+	-	+
Tular Dandi	<i>Sillaginopsis panijus</i>	NO	+	-	+	-	+	-	+	-	-	-	+	-
Paira Chanda	<i>Scatophagus argus</i>	DD	+	-	-	-	-	-	-	-	-	+	-	-
Paissa	<i>Liza parsia</i>	NO	+	+	+	+	+	+	+	+	+	+	+	+
Pangas	<i>Pangasius pangasius</i>	CR	+	-	+	-	-	-	-	+	-	-	-	+
Tak Chanda	<i>Leiognathus equulus</i>	NO	+	-	-	-	-	-	+	-	-	+	-	-
Phessa	<i>Setipinna phasa</i>	NO	+	+	+	+	+	+	+	+	+	-	+	-
Teli Phessa	<i>Setipinna phasa</i>	DD	-	-	+	-	-	-	-	-	-	+	-	-
Poma	<i>Poma poma</i>	NO	+	+	+	+	+	+	+	+	+	+	+	+
Potka	<i>Chelonodon patoca</i>	NO	+	+	-	+	+	+	-	+	+	-	+	+
Shilong	<i>Silonia silondia</i>	EN	+	-	+	-	-	-	-	-	-	-	+	-
Tailla	<i>Eleutheronema tetradactylum</i>	DD	+	-	-	-	-	-	-	-	-	+	-	-
Tapse	<i>Polynemus paradiseus</i>	DD	+	+	+	-	-	+	+	+	-	-	+	+
Daitna	<i>Acanthopagrus latus</i>	DD	-	-	-	+	-	-	-	+	+	-	+	+
Shole	<i>Channa striatus</i>	DD	-	-	-	+	-	-	-	+	-	-	-	-
Magur	<i>Clarias batrachus</i>	DD	-	-	-	+	-	-	-	+	-	-	-	+
Koi	<i>Anabas testudineus</i>	DD	-	-	-	+	-	-	-	+	-	+	-	-
Vetki	<i>Lates calcarifer</i>	DD	-	-	-	+	+	+	+	+	+	-	+	+

Table D.2: Occurrence of Species (13<sup>th</sup> to 21<sup>st</sup> QM)

Local Name	Scientific Name	Local Status*	13 <sup>th</sup> QM	14 <sup>th</sup> QM	15 <sup>th</sup> QM	16 <sup>th</sup> QM	17 <sup>th</sup> QM	18 <sup>th</sup> QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	21 <sup>st</sup> QM	22 <sup>nd</sup> QM
		‘-’ = No; ‘+’ = Occurrence										
Hilsa	<i>Tenualosa ilisha</i>	NO	-	-	-	-	-	+	-	-	-	+
Sagor Baim	<i>Anguilla bengalensis</i>	NT	-	-	-	-	-	-	-	-	-	-
Bacha	<i>Eutropiichthys vacha</i>	CR	+	-	-	-	-	-	-	-	-	+
Bagda Chingri	<i>Penaeus monodon</i>	DD	+	-	+	+	+	+	+	+	+	+
Banspata	<i>Brachypleura novae-zeelandiae</i>	NO	+	+	+	+	+	+	+	+	+	-
Kukurjib	<i>Cynoglossus lingua</i>	NO	-	-	+	-	-	-	+	-	+	+
Bele	<i>Glossogobius giuris</i>	NO	+	+	+	+	+	+	+	+	+	+
Aswine Bele	<i>Butis butis</i>	NO	+	+	+	+	+	-	+	+	-	-
Bairagi	<i>Coilia dussumieri</i>	NO	+	+	+	+	+	+	+	+	+	-
Boishakhi Chingri	<i>Macrobrachium</i> sp.	NO	-	-	-	-	+	-	-	-	-	-
Chammu Chingri	<i>Metapenaeus brevicornis</i>	DD	-	+	+	+	+	+	+	+	+	+
Chaka Chingri	<i>Penaeus indicus</i>	DD	+	-	+	+	+	+	+	+	+	+
Ghora Chela	<i>Securicula gora</i>	-	-	-	-	-	-	-	-	-	-	-
Chanda Chela	<i>Securicula</i> sp.		-	-	+	+	+	+	-	-	-	+
Sada Chewa	<i>Trepachen vagina</i>	NO	-	-	-	+	-	-	-	+	-	+
Lal Chewa	<i>Taenioides cirratus</i>	NO	+	+	-	+	+	-	+	+	-	-
Chhuri	<i>Trichiurus muticus</i>	NO	-	-	-	+	-	-	-	-	-	-
Sagor Chela	<i>Megalops cyprinoids</i>	NO	-	-	-	-	-	-	-	-	-	-
Purabi Chela	<i>Thryssa purava</i>	NO	-	-	-	-	-	-	-	-	-	-
Kabashi Tengra	<i>Mystus cavasius</i>	DD	-	-	-	-	+	-	-	-	-	-
Gagra Tengra	<i>Nemapteryx nenga</i>	DD	+	+	+	+	+	+	+	+	+	-
Gulsha Tengra	<i>Mystus bleekery</i>	DD	+	+	+	+	+	-	+	+	+	-
Harina Chingri	<i>Metapenaeus ensis</i>	DD	+	+	+	+	+	+	+	+	+	+
Ekthuto	<i>Hyporhamphus limbatus</i>	NO	+	+	-	-	+	+	+	+	+	+
Kakila	<i>Xenentodon cancila</i>	NO	-	+	-	-	+	-	-	-	-	+
Chapila	<i>Gudusia chapra</i>	NO	-	-	-	-	+	+	+	-	+	+
Kuchia	<i>Monopterusuchia</i>	DD	+	+	+	+	+	+	-	+	+	-
Loitta	<i>Harpodon nehereus</i>	NO	+	-	+	-	-	-	-	+	-	-
Motka Chingri	<i>Macrobrachium villosimanusless</i>	DD	+	+	+	+	+	+	+	+	+	+
Mud Crab	<i>Scylla serrata</i>	NO	+	+	+	+	-	+	+	+	-	+
Tular Dandi	<i>Sillaginopsis panijus</i>	NO	-	+	-	-	-	+	+	+	+	-
Paira Chanda	<i>Scatophagus argus</i>	DD	-	-	-	-	-	-	+	-	-	-
Paissa	<i>Liza parsia</i>	NO	+	+	+	+	-	+	+	+	+	+
Pangas	<i>Pangasius pangasius</i>	CR	-	-	-	-	-	+	+	+	+	+
Tak Chanda	<i>Leiognathus equulus</i>	NO	-	-	-	-	-	-	-	-	-	-
Pheksa	<i>Setipinna phasa</i>	NO	+	+	-	+	-	-	+	+	+	+
Teli Pheksa	<i>Setipinna phasa</i>	DD	-	-	-	-	-	-	-	-	-	-
Poma	<i>Poma poma</i>	NO	+	+	+	+	+	+	+	+	+	+
Potka	<i>Chelonodon patoca</i>	NO	+	+	+	+	+	+	+	+	-	-
Shilong	<i>Silonia silondia</i>	EN	+	+	-	-	-	-	-	-	-	+
Tailla	<i>Eleutheronema tetradactylum</i>	DD	-	-	-	-	-	+	-	+	+	-
Tapse	<i>Polynemus paradiseus</i>	DD	-	+	+	+	+	+	+	+	+	-
Daitna	<i>Acanthopagrus latus</i>	DD	-	+	+	+	-	+	+	+	-	-
Shole	<i>Channa striatus</i>	DD	-	+	+	-	-	-	-	-	-	-
Magur	<i>Clarias batrachus</i>	DD	-	+	+	-	-	-	-	-	-	-
Koi	<i>Anabas testudineus</i>	DD	-	-	-	-	-	-	-	-	-	-
Vetki	<i>Lates calcarifer</i>	DD	+	+	+	+	-	+	+	-	+	-

\*Local Status Source: IUCN Red List

**Table D.3: Length-wise species distribution (%) in sampling sites**

Fish Species	Site	L (< 2cm)	L (2 to 3cm)	L (3 to 5cm)	L (5 to 10cm)	L (10 to 20cm)	L (> 25cm)	Brood Fish
Amadi	Maidara	0	0	100	0	0	0	0
Bagda	Chandpai	100	0	0	0	0	0	0
Baila	Chandpai	100	0	0	0	0	0	0
	Maidara	0	0	0	100	0	0	0
Batasi	Chalna Point	0	0	0	100	0	0	0
Chali	Chalna Point	0	0	100	0	0	0	0
Chamua Chingri	Chandpai	100	0	0	0	0	0	0
Chanda	Chandpai	100	0	0	0	0	0	0
Chapila	Chalna Point	0	0	0	100	0	0	0
Chela	Chandpai	100	0	0	0	0	0	0
	Mongla	0	0	0	0	100	0	0
Chewa	Chalna Point	0	0	0	0	100	0	0
	Maidara	0	0	0	75	25	0	0
	Mongla	0	0	0	100	0	0	0
Corina	Chandpai	100	0	0	0	0	0	0
Darkina	Mongla	0	0	100	0	0	0	0
Ghaura	Chalna Point	0	0	0	7	93	0	0
	Maidara	0	0	0	67	33	0	0
Goda Chingri	Mongla	0	0	0	100	0	0	0
Harina	Maidara	0	0	0	100	0	0	0
	Mongla	0	0	100	0	0	0	0
Ilish	Chalna Point	0	0	0	0	0	100	0
	Maidara	0	0	0	0	0	100	0
Kathali	Mongla	0	0	0	100	0	0	0
Khoira	Maidara	0	0	100	0	0	0	0
Khorsul	Maidara	0	0	100	0	0	0	0
Kumirer Khil	Chandpai	100	0	0	0	0	0	0
Motka Chigri	Chandpai	100	0	0	0	0	0	0
	Maidara	0	0	100	0	0	0	0
Mutkura	Chandpai	100	0	0	0	0	0	0
Paissa	Chandpai	100	0	0	0	0	0	0
	Mongla	0	0	0	67	33	0	0
Pangas	Maidara	0	0	0	0	100	0	0
Pata	Chalna Point	0	0	0	27	0	73	0
Phesa	Chalna Point	0	0	0	0	100	0	0
Poa	Maidara	0	0	100	0	0	0	0
Poikka	Chandpai	100	0	0	0	0	0	0
Punti	Mongla	0	0	100	0	0	0	0
Taki	Mongla	0	0	0	60	40	0	0
Telo Taki	Mongla	0	0	0	0	100	0	0
Tilapia	Mongla	0	0	100	0	0	0	0

Source: CEGIS field survey, 2019

Table D.4: Purpose, timing and extent of migration for different year-class of migratory fish species

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
Tapsi	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-	-	-	-
	Akram Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	-	-	Feeding	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	Feeding	-	-	-	-
	Chalna Point	Age-1 adult and Brood fish	Feeding and Growing	Spawning	-	-	-	Feeding	Feeding and Spawning	-	-	-	Feeding and Growing	-
		Adult	-	-	Feeding and Growing	-	-	Feeding	Feeding	-	-	-	-	-
	Harbaria	Juvenile and Age-1 adult	Feeding and Growing	Feeding and Growing	-	-	-	-	-	-	-	-	-	Feeding
		Adult and Brood Fish	-	-	Breeding and Spawning	-	-	-	-	-	-	-	-	-
	Chandpai	Juvenile	-	-	Feeding and Growing	-	-	-	Feeding	-	-	-	Feeding	-
	Mongla Point	Adult	-	-	-	-	-	-	-	-	-	-	-	-
	South-west of the Project	Age-1 adult	Feeding and Growing	Feeding and Growing	Feeding and Growing	-	-	Feeding	-	-	-	-	-	-
		Brood Fish	-	-	-	-	-	Breeding and Spawning	-	-	-	-	-	-
Bairagi	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-	-	-	-
	Akram Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-	-	-	-
		Juvenile and Adult	-	-	-	-	-	-	-	Growing	-	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
										and Feeding				
	Chandpai	Fry	Breeding and Spawning	Breeding and Spawning	Feeding and Growing	Feeding	-	Feeding	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	-	-	-		-	-
	Chalna Point	Juvenile and Age-1 adult	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	-		-	Nursing
	Harbaria	Juvenile	Feeding and Growing	-	-	-	-	Feeding	-	-	-		-	-
	Mongla Point	Fry	-	Nursing	-	Feeding	-	-	-	-	-		-	Nursing
		Juvenile	-	-	-	-	-	-	-	Feeding	-		-	-
Chapila	South-west of the Project	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	-		-	Nursing
		Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
		Age-1 adult	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	Haldikhali	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Mongla Point	Fry	-	Nursing	-	-	-	-	-	-	-		-	-
	South-west of the Project	Age-1 adult	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
Loitta	Haldikhali	Juvenile and Age-1 adult	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	Feeding and Growing	-	-	-	-		-	-
	Akram Point	Age-1 adult	-	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-		-	-
	Chandpai	Juvenile	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Harbaria	Fry, Juvenile and	-	Nursing,	-	-	-	-	-	-	-		-	-



Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
		Age-1 adult		Feeding and Growing										
	Chalna Point	Age-1 adult	-	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	Nursing		-	-
Poma	Haldikhali	Juvenile	Feeding and Growing	-	-	Feeding	-	-	-		-		-	-
	Akram Point	Juvenile	Feeding and Growing	-	-	-	-	-	-	Growing and Feeding	-		-	-
		Age-1 adult	-	-	Feeding and Growing	-	-	-	Feeding	Feeding	-		-	-
		Adult	-	-	-	-	-	-			-		-	-
	Chandpai	Fry and Juvenile	Breeding and Spawning	Nursing	-	-	-	Feeding	-	-	-		-	-
		Juvenile	-	-	Feeding and Growing	Feeding	Feeding and Growing	-	Feeding and Growing		-		Feeding and Growing	
		Adult	-	-	-	-	-	-	Feeding		-			
		Brood Fish	-	-	-	-	-	-			-		Spawning	-
	Haldikhali	Fry and Juvenile	-	-	Nursing	-	-	-	-	-	-		-	-
	Harbaria	Adult and Brood Fish	-	-	Breeding and Spawning	-	-	-	-	-	-		Feeding and Spawning	-
		Adult	-	-	-	-	-	-	Feeding		-		-	Feeding
		Fry and Juvenile						Spawning and Nursery	-	-	Feeding and Growing		-	-
	Mongla Point	Fry, Juvenile and Age-1 adult	-	-	Spawning, Feeding and Growing	-	-	-	-	Nursing	-		-	Nursing
		Juvenile	-	-	-	-	-	-	Feeding and Growing		-		-	-
		Age-1 Adult	-	-	-	-	-	-	Feeding	Feeding	-		-	-
		Adult	-	-		Feeding	-	Feeding	-	-	-		Feeding	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
		Brood Fish	-	-	-	-	-	-	-	-	-		Spawning	-
	South-west of the Project	Adult	-	-	Feeding	Feeding	-	Feeding	-	-	-		-	-
	Chalna Point	Juvenile, Adult and Brood Fish	Breeding and Spawning	-	-	-	-	-	-	-	-		Feeding, Growing and Spawning	-
		Juvenile and Adult	-	-	Feeding and Growing	Feeding and Growing	-	Feeding and Growing	-	-	-		-	-
		Fry	-	-	-	-	-	-	-	-	Nursery		-	Nursing
Chhuri	Haldikhali	Adult	Feeding	-	Feeding	-	-	-	-	-	-		-	-
	Akram Point		Feeding	-	Feeding	-	-	-	-	-	-		-	-
Chela	Haldikhali	Adult	Feeding	-	Feeding	-	-	-	-	-	-		-	-
	Akram Point	Juvenile and Adult	Feeding and Growing	-	-	-	-	-	-	-	-		-	-
	Harbaria	Fry and Juvenile	-	Feeding and Growing	-	-	-	Nursery	-	-	-		-	-
	Chandpai		-	-	-	-	-	-	-	Growing and Feeding	Nursery		-	-
Gang Tengra	Haldikhali	Adult	Feeding	-	Feeding	Feeding	-	-	-	-	-		-	-
	Akram Point	Adult	Feeding and Breeding	-	-	Feeding	-	-	-	-	-		-	-
	Harbaria	Adult	-	-	Feeding	-	-	-	-	-	-		-	-
	Chandpai	Adult	-	-	Feeding	Feeding	-	-	-	-	-		-	-
Gagra Tengra	Chandpai	Juvenile and Age-1 adult	-	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-		-	-
	Chalna Point	Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-		-	-
	Mongla Point	Age-1 adult	-	Feeding and Growing	-	-	-	-	-	-	-		-	-
	Akram Point	Juvenile and Adult	-	-	Feeding and Growing	-	-	-	-	-	-		-	Feeding

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
		Adult	-	-	-	-	-	-	Feeding	-	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-	-	-	-
	Harbaria	Adult	-	-	Feeding	-	Feeding and Growing	-	-	-	Feeding	-	Feeding	-
Gulsha Tengra	Haldikhali	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-	-	-	-
	Akram Point	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-	-	-	-
	Chandpai	Age-1 adult	-	-	-	Feeding	-	Feeding	Feeding and Growing	-	-	-	-	Feeding
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-	-	Feeding and Growing	-
	Mongla Point	Age-1 adult	-	Feeding and Growing	-	Feeding and Growing	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-	-	Feeding and Growing	-
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-	-	Feeding and Growing	-
		Age-1 adult	-	-	-	-	-	-	-	-	Feeding and Growing	-	-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing	-	Feeding and Growing	-	-	-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	-	-	Feeding and Growing	-
Potka	Haldikhali	Adult	Feeding and Breeding	-	-	-	-	-	-	-	-	-	-	-
	Chandpai	Fry	Spawning	Spawning and Nursing	-	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-	-	-	Feeding
		Adult	-	-	-	Feeding	-	-	-	-	-	-	Feeding	-
	Mongla Point	Fry	Spawning	-	-	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
	Harbaria	Fry	-	-	-	-	-	Nursery	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-	-	-	-
Paira Chanda	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-	-	-	-
	Chandpai	Fry	Breeding and Spawning	-	-	-	-	-	-	-	-	-	-	-
Chewa	Akram Point	Juvenile and Adult	Feeding	-	Feeding and Growing	-	-	-	-	-	-	-	-	-
	Chandpai	Fry and Juvenile	Spawning	-	Feeding and Growing	-	Nursing and Grazing	Nursery	Feeding and Growing	-	Nursing	-	-	-
		Adult	-	-	-	Feeding	-	Feeding	-	Feeding	-	-	-	-
	Haldikhali	Juvenile and Adult	-	-	Feeding and Growing	-	-	-	-	-	-	-	-	-
	Harbaria	Juvenile and Adult	-	-	Feeding and Growing	-	-	Feeding and Nursery	-	Feeding	-	-	-	-
	Mongla Point	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-	-	-	-
	South-west of the Project	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	-	-	-	-
	Chalna Point	Adult	-	-	-	-	Feeding	-	-	-	-	-	-	-
		Age-1 Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing	-	-	-
Bele	Akram Point	Adult	Feeding	-	Feeding	Feeding	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	Feeding and Growing	-	-	-	-
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	Nursing and Growing	Feeding	-	-	-	-	-	-	-	-
	Harbaria	Juvenile and Adult	-	-	Feeding	-	Feeding	Nursery	Feeding	-	-	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
					and Growing		and Growing	and Feeding	and Growing					
	Chandpai	Fry	Breeding and Spawning	Nursing	-	-	Nursing	Nursery	-	-	Nursery		-	-
	Chandpai	Juvenile and Adult	-	-	Feeding and Growing	Feeding	-	Feeding	-	Feeding	-		Feeding and Growing	
	Harbaria	Juvenile and Age-1 Adult	-	-	-	-	-	-	Feeding and Growing				-	-
	Mongla Point	Fry	Breeding and Spawning	-	-	-	-	Nursery	-	-	-		-	-
	Mongla Point	Fry, Juvenile-1 and Juvenile			Nursing and Growing	-	-	-	-	-	-		-	-
	Mongla Point	Juvenile and Adult	-	-	-	Feeding	Feeding and Growing	Feeding	Feeding and Growing	-	-		-	-
	Chalna Point	Fry	Breeding and Spawning	Nursing	-	-	Nursing	-	-	Nursing	-		-	-
	Chalna Point	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Maidara	Juvenile and Age-1 adult	-	Feeding and Growing	Feeding and Growing	Feeding	Feeding and Growing	-	-	-	Feeding and Growing		-	-
		Fry	-	-	-	-	-	-	-	Nursing	-		-	Nursing
Tular Dandi (Nona bele)	Akram Point	Adult	Feeding	-	-	-	-	-	-	-	-		-	-
	South-west of the Project	Adult	-	-	Feeding	-	-	-	-	-	-		Feeding	-
	Chalna Point	Adult	Feeding	-	Feeding	-	Feeding	-	Feeding	-	-		-	-
Tairel	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
	Harbaria	Age-1 Adult	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Mongla Point	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	-
Phekssa	Akram Point	Adult	Feeding	-	-	-	-	-	-	Feeding	-		-	-
		Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-		-	-
	Haldikhali	Juvenile	-	-	Feeding	-	-	-	-	-	-		-	-



Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
					and Growing									
	Haldikhali	Adult	-	-	-	Feeding	-	-	-	-	-		-	-
	Harbaria	Juvenile	-	-	-	-	-	-	-	-	Feeding and Growing		-	-
	Chalna Point	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	Feeding and Growing	-	Feeding and Growing		-	-
		Adult	-	-	Feeding	Feeding	Feeding	-	Feeding	-	-		-	-
	Mongla Point	Adult	-	-	Feeding	Feeding	-	-	Feeding	-	-		Feeding	-
	Chandpai	Juvenile and Adult	Feeding	Feeding and Growing	-	-	Feeding and Growing	-	Feeding and Growing	-	-		-	-
	Maidara	Juvenile and Adult	Feeding	Feeding and Growing	-	-	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
		Adult	-	-	Feeding	Feeding	-	Feeding	-	-	-		-	-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	Feeding and Growing	Feeding	-	-	-	Feeding and Growing	-		-	Feeding
		Brood	-	-	-	-	-	-	-	-	-		-	Spawning
		Juvenile	-	-	-	-	-	-	Feeding and Growing			-	-	-
	Haldikhali	Juvenile and Adult	Feeding	-	Feeding and Growing	Feeding	-	-	-	-	-		-	-
		Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	-
	Harbaria	Juvenile-1 and Juvenile	-	-	Feeding	-	Feeding and Growing	-	Feeding and Growing	-	-		-	-
		Adult	-	-	-	-	-	-	-	Feeding	-		-	-
	Chandpai	Fry	Breeding and Spawning	-	-	-	Nursing	-	-	-	Nursery		-	-
	Chandpai	Juvenile and Adult	-	-	Feeding and	-	-	Nursery and	-	-	-		Feeding and Growing	Feeding

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
					Growing			Feeding						
	Harbaria	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-			-
	Mongla Point	Fry	Breeding and Spawning	-	-	-	-	Nursery	-	-	Nursery		-	-
		Age-1 Juvenile	-	-	-	-	-	-	-Nursing, Feeding and Growing	-			-	-
		Age-1 Adult	-	-	-	-	Feeding and Growing	Feeding	-	-	Feeding and Growing		-	-
	Maidara	Fry, Juvenile and Age-1 adult	Breeding and Spawning	Feeding and Growing	-	-	Feeding and Growing	-	-	-			-	-
		Age-1 Juvenile, Juvenile and Age-1 Adult	-	-	-	-	-	-	Nursing, Feeding and Growing	-	-		Feeding and Growing	-
		Adult	-	-	-	-	-	Feeding	-	-	-		-	
	Chandpai	Juvenile	Feeding	-	-	-	-	-	-	-	-		-	
Banshpata		Adult	-	-	-	Feeding	-	Feeding	-	-	-		-	
	Akram Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-		-	
		Adult	-	-	-	-	-	-	-	Feeding	-		-	
	Haldikhali	Juvnile and adult	-	-	Feeding and Growing	Feeding	-	-	Feeding and Growing	-	-		-	
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	Feeding		Feeding	
	Mongla Point	Fry and Adult	Feeding	Nursing	-	-	-	-	-	-	-		-	
		Adult	-	-	-	Feeding	-	-	-	-	Feeding		-	
	Maidara	Adult	-	-	Feeding	Feeding	-	Breeding and Spawning	-	-	-		-	
	Chalna Point	Adult	-	-	Feeding	Feeding	-	-	-	-	-		-	
Hilsa	Akram Point	Brood Fish	-	-	-	-	-	-	-	-	-		Breeding and	

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose											
			1st QM	2 <sup>nd</sup> QM	3 <sup>rd</sup> QM	4 <sup>th</sup> QM	5 <sup>th</sup> QM	6 <sup>th</sup> QM	7 <sup>th</sup> QM	8 <sup>th</sup> QM	9 <sup>th</sup> QM	10 <sup>th</sup> QM	11 <sup>th</sup> QM	12 <sup>th</sup> QM
	Haldikhali	Brood Fish	-	-	-	-	-	-	-	-	-	-	Spawning	
		Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-	-	-	
	Harbaria	Brood Fish	-	-	-	-	-	-	-	-	-	-	Breeding and Spawning	
	Chandpai	Adult and Brood Fish	-	-	-	-	-	-	Feeding and Breeding	-	-	-	-	
	Mongla Point	Adult	-	-	Feeding	-	-	-	-	-	-	-	-	
		Brood Fish	-	-	-	-	-	-	-	-	-	-	Breeding and Spawning	
	Maidara	Age-1 Adult	-	-	-	-	-	-	-	-	-	-	Feeding	
Pangas	Chalna Point	Brood fish	-	-	-	-	-	Breeding and Spawning	-	-	-	-	-	
	Haldikhali	Juvenile	-	-	Feeding and Growing	-	-	-	-	-	-	-	-	
	Harbaria	Adult	-	-	-	-	-	-	-	Feeding	-	-	-	
	Mongla Point	Juvenile and Adult	-	-	Feeding	-	-	-	-	-	-	-	-	

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
Tapsi	Haldikhali	Juvenile and Age-1 adult	-	-	Grazing	-	-	-	-	-	-
	Akram Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-	-
	Chalna Point	Age-1 adult and Brood fish	-	-	-	-	-	-	-	-	-
		Adult	-	Feeding	-	-	Feeding	-	-	Feeding	Feeding
	Harbaria	Juvenile and Age-1 adult	Feeding	-	-	-	-	-	-	-	-
		Adult and Brood Fish	-	-	-	-	-	-	-	-	-
	Chandpai	Juvenile	-	Feeding and Growing	-	Feeding and Growing	Feeding and Growing	-	-	-	-
	Mongla Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-
		Adult	-	-	-	-	-	-	-	-	-
		Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-
		Fry	-	-	Nursing	-	-	-	-	-	-
	Maidara	Age-1 adult	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	Maturation	-	-	-
		Adult	-	-	-	-	Feeding	-	-	-	-
		Brood Fish	-	-	-	-	-	-	-	-	-
Bairagi/Amadi	Haldikhali	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-
	Akram Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-
		Juvenile and Adult	-	-	-	-	-	-	-	-	-
	Chandpai	Fry	-	Nursing	-	Nursing	-	-	-	Nursing	-
		Juvenile	-	Feeding and Growing	Feeding and Growing	Feeding and Growing	-	Maturation	Feeding and Growing	-	Nursing
	Chalna Point	Juvenile and Age-1 adult	-	-	-	-	-	-	-	Feeding	-
		Fry	Nursing	-	-	-	-	Nursing	-	Nursing	-
	Harbaria	Juvenile	-	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-
	Mongla Point	Fry	Nursing	-	Nursing	-	-	-	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-
	Maidara	Juvenile	-	-	-	-	-	Maturation	-	-	-
		Fry	Nursing	-	Nursing	-	-	Nursing	-	Nursing	-
	Charaputia	Adult	-	-	-	-	-	-	-	Feeding	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-
Chapila	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-	-
	Harbaria	Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-
	Mongla Point	Fry	-	-	-	-	Nursing	-	-	-	-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-
		Adult	-	-	-	-	Feeding	-	Maturation	-	-
	Chalna Point	Adult	-	-	-	-	Feeding	-	Maturation	-	Maturation
		Fry	-	-	-	-	-	Nursing	-	-	-
	Maidara	Juvenile to Age-1 adult	-	-	-	-	-	Growing and Maturation	-	-	-
Loitta	Haldikhali	Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-	-
	Akram Point	Age-1 adult	-	-	-	-	-	-	-	-	-
	Chandpai	Juvenile	-	-	-	-	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-
	Harbaria	Fry, Juvenile and Age-1 adult	-	-	-	-	-	-	-	-	-
	Mongla Point	Fry	-	-	Nursing	-	-	-	-	-	-
	Chalna Point	Age-1 adult	-	-	-	-	-	-	-	-	-
		Fry	-	-	-	-	-	-	-	-	-
Poma	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-	-
		Age-1 adult	-	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-	-
		Brood Fish	-	-	-	Spawning	-	-	-	-	-
	Charaputia	Juvenile and Adult	-	-	-	Feeding	-	-	Growing and Maturation	Feeding	-
		Fry and Juvenile	-	-	-	Nursing	-	-	-	-	-



Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
		Fry	-	-	-	-	Nursing	-	-	-	-
		Juvenile	Feeding and Growing	-	-	Feeding and Growing	-	-	-	-	-
		Adult		Feeding	Feeding	Feeding	-	-	-	-	-
		Brood Fish	-	-	-	-	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-
	Haldikhali	Fry and Juvenile	-	-	-	-	-	-	-	-	-
	Harbaria	Adult and Brood Fish	-	-	-	-	-	-	-	-	-
		Adult	Feeding	-	-	-	-	Feeding	-	-	-
		Fry and Juvenile	-	-	-	-	-	-	-	-	-
	Mongla Point	Fry, Juvenile and Age-1 adult	Nursing	-	-	-	Nursing	-	Feeding and Growing	-	-
		Fry	-	Nursing	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	Nursing
		Age-1 Adult	-	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-	-
		Brood Fish	-	-	-	-	-	-	-	-	-
	Maidara	Adult	-	Feeding	-	-	-	-	Maturation and Feeding	-	-
		Fry	-	-	-	-	-	Nursing	-	-	-
	Chalna Point	Juvenile, Adult and Brood Fish	-	-	-	-	-	-	-	-	-
		Juvenile and Adult	-	Feeding and Growing	-	-	-	Maturation and Feeding	Maturation and Feeding	-	Maturation and Feeding
		Fry	Nursing	-	-	-	-	-	-	-	-
Chhuri	Haldikhali	Adult	-	-	-	-	-	-	-	-	-
	Akram Point		-	-	-	-	-	-	-	-	-
Chela	Haldikhali	Adult	-	-	-	-	-	-	-	-	-
	Akram Point	Juvenile and Adult	-	-	-	-	-	-	-	-	-
	Harbaria	Fry and Juvenile	-	-	-	-	-	-	-	-	-
	Chalna Point		-	-	-	Nursing and Feeding	-	-	-	-	-
	Chandpai		-	-	Feeding and Growing		-	-	-	Nursing	Nursing
	Mongla Point		-	Nursing	-	-	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-
Gang Tengra	Haldikhali	Adult	-	-	-	-	-	-	-	-	-
	Akram Point	Adult	-	-	-	-	-	-	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
	Harbaria	Adult	-	-	-	-	-	-	-	-	-
	Chandpai	Adult	-	-	-	-	Feeding	-	-	-	-
	Maidara	Fingerling	-	-	-	-	Nursing	-	-	-	-
	Mongla Point	Fingerling					Nursing	-	-	-	-
		Age-1 Adult					Feeding and Growing	-	-	-	-
Ghagra Tengra	Chandpai	Juvenile and Age-1 adult	-	-	-	-	-	Maturation		-	-
		Brood Fish	-	-	Breeding	-	-	-	-	-	-
		Fry	-	-	-	-	Nursing	-	-	-	-
	Chalna Point	Age-1 adult	-	-	-	-	-	-	-	-	-
	Mongla Point	Age-1 adult	-	-	-	-	-	-	Maturation and Feeding	-	Maturation and Feeding
	Akram Point	Juvenile and Adult	Feeding	-	-	-	-	-	-	Feeding and Growing	-
		Adult	-	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-
	Harbaria	Adult	Feeding		Breeding	-	-	-	-	Feeding	-
		Juvenile	-		-	-	-	Maturation	-	Maturation	-
Gulsha Tengra	Charaputia	Juvenile and Age-1 adult	-						Maturation	-	-
	Haldikhali	Adult	-	-	-	-	-	-	-	-	-
	Akram Point	Adult	-	-	-	-	-	-	-	-	-
	Chandpai	Age-1 adult	Feeding	-	Feeding and Growing	-	-	-	-	-	-
		Juvenile	-	Feeding and Growing	-	Feeding and Growing	-	-	-	-	-
	Charaputia	Juvenile	-	-	-	Feeding and Growing	-	-	Feeding and Growing	-	-
			-	-	-		-	-	-	-	-
	Mongla Point	Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-
	Harbaria	Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-
		Age-1 adult	-	-	-	-	Feeding and Growing	-	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-	-
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	-
Potka	Haldikhali	Adult	-	-	-	-	-	-	-	-	-
	Chalna Point	Fry	-	-	-	-	-	Nursing	-	-	-
		Fry	-	-	-	-	-	-	-	Nursing	-
	Chandpai	Juvenile	Feeding	-	-	-	-	-	Feeding and Growing	-	-
		Adult	-	Feeding and Growing	Feeding	-	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-
	Mongla Point	Fry	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	-
	Maidara	Fry	-	-	-	Nursing	-	Nursing	-	Nursing	-
		Juvenile	-	-	-	-	-	Maturation	-	-	-
	Harbaria	Fry	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	-
	Charaputia	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	-
Paira Chanda	Akram Point	Adult	-	-	-	-	-	-	-	-	-
	Chandpai	Fry	-	-	-	-	-	-	-	-	-
Chewa	Akram Point	Juvenile and Adult	-	-	-	-	-	-	-	-	-
		Fry and Juvenile	-	-	-	-	-	-	-	Nursing	-
	Chandpai	Juvenile	-	Feeding and Growing	-	-	-	-	-	-	Feeding and Growing
		Adult	-	-	-	-	-	-	-	-	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-
	Haldikhali	Juvenile and Adult	-	-	-	-	-	-	-	-	-
	Harbaria	Juvenile and Adult	-	-	-	-	-	-	-	-	-
	Chandpai	Juvenile-1	-	-	-	-	Feeding and Growing	-	-	-	-
	Mongla Point	Juvenile	-	-	-	-	-	-	-	-	Nursing
		Fry	-	-	-	-	Nursing	-	-	-	-
	Maidara	Juvenile	-	-	-	-	-	-	-	-	-
		Fry	-	-	Nursing	-	-	-	-	-	-
	Chalna Point	Adult	-	-	-	-	Feeding	-	-	-	-
		Age-1 Juvenile	-	-	-	-	-	-	-	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
Bele	Akram Point	Adult	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile-1, Juvenile and Adult	-	-	-	-	-	-	-	-	-
	Harbaria	Juvenile and Adult	-	-	-	-	-	-	-	-	-
	Chandpai	Fry	-	-	-	Nursing	Nursing	-	-	Nursing	-
		Juvenile and Adult	Feeding and Growing	-	Feeding and Growing		-	-	-	-	Feeding and Growing-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-
	Harbaria	Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-	-
	Mongla Point	Fry	-	Nursing	-	-	Nursing	-	-	-	-
		Fry, Juvenile-1 and Juvenile	-	-	-	-	-	-	-	-	-
		Juvenile and Adult	-	-	-	-	-	-	-	-	Maturation and Feeding
	Chalna Point	Fry	-	-	Nursing		Nursing	-	-	-	-
		Fingerling	-	-	-	-	Nursing	-	-	-	-
		Adult	-	-	-	-	-	-	-	-	-
	Maidara	Juvenile and Age-1 adult	-	-	Feeding and Growing	-	Feeding and Growing	Feeding and Growing	-	-	Maturation and Feeding
		Fry	Nursing	-	Nursing		-	-	-	-	-
	Charaputia	Juvenile and Age-1 adult	-	-	-	-	-	-	Maturation	-	-
Tular Dandi (Nona bele)	Akram Point	Adult	-	-	-	-	-	-	-	Feeding and Maturation	-
	Chandpai	Age-1 Adult	-	-	Feeding	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	Growing	-	-	-
		Fry	-	-	-	-	-	-	-	Nursing	-
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	-
	Maidara	Adult	-	Feeding	-	-	-	-	Maturation	-	-
	Chalna Point	Adult	-	-	-	-	-	-	Maturation	Maturation	Maturation and Feeding
Tairel	Akram Point	Adult	-	-	-	Feeding	-	-	-	-	-
	Charaputia	Juvenile	-	-	-	-	-	-	-	Maturation	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
	Harbaria	Age-1 Adult	-	Feeding and Growing	-	-	-	-	-	-	-
	Chandpai	Juvenile	-	-	-	-	-	Growing	-	-	Feeding and Growing
	Chalna Point	Juvenile	-	-	-	-	-	-	-	-	Growing
	Maidara	Juvenile	-	-	-	-	-	Growing	-	-	-
	Mongla Point	Juvenile	-	-	-	-	-	-	-	-	-
Phekssa	Akram Point	Adult	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-
	Haldikhali	Adult	-	-	-	-	-	-	-	-	-
	Charaputia	Juvenile and Adult	-	-	-	-	-	-	-	Feeding and Maturation	-
	Harbaria	Juvenile	-	-	-	-	-	-	-	-	-
	Chalna Point	Juvenile and Adult	-	-	-	Feeding and Growing	-	-	-	Maturation	Maturation
		Adult	-	Feeding	-	-	-	-	Maturation	-	-
	Mongla Point	Adult	-	-	-	-	-	-	Maturation	-	-
		Juvenile	-	-	-	Growing	-	-	-	-	-
	Chandpai	Juvenile and Adult	-	-	-	Feeding and Growing	-	-	Maturation	--	-
	Maidara	Juvenile and Adult	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	-
		Adult	-	Feeding	-	-	-	-	-	-	-
Paissa	Akram Point	Juvenile and Adult	Feeding	-	-	-	-	Growing and Maturation	-	-	-
		Brood	Spawning	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile and Adult	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	-
	Charaputia	Brood Fish	-	--	-	Spawning	-	-	-	-	-
	Harbaria	Juvenile-1 and	-	Feeding and	-	-	-	-	-	-	-



Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
		Juvenile		Growing							
		Adult	-	Feeding	-	-	-	-	-	-	-
	Chalna	Fry	-	-	-	-	-	-	Feeding and Growing	-	Feeding and Growing
	Chandpai	Fry	-	-	-	Nursing	-	-	Feeding and Growing	Nursing	Nursing
		Juvenile and Adult	Feeding	Feeding and Growing	-	Feeding and Growing	-	Maturation	-	-	
	Jongra	Fry	-	-	-	-	-	-	-	Nursing	
	Harbaria	Juvenile	-	-	Feeding and Growing	-	-	Maturation	-	-	
	Mongla Point	Fry	-	-	Nursing	-	-	-	-	-	
		Age-1 Juvenile	-	-	-	-	-	-	-	-	
		Age-1 Adult	-	-	-	-	-	-	-	-	
	Maidara	Fry, Juvenile and Age-1 adult	-	-	-	-	-	-	Feeding and Growing	-	Feeding and Growing
		Age-1 Juvenile, Juvenile and Age-1 Adult	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	Growing	-	-	-
		Adult	-	-	-	-	-	-	-	-	-
Banshpata	Chandpai	Juvenile	-	-	-	Growing	Feeding and Growing	-	-	-	-
		Adult	-	Feeding	Feeding	-	-	-	-	-	-
	Jongra	Juvenile	-	-	-	-	-	-	-	Maturation	-
	Charaputia	-	-	-	-	Feeding	-	-	Growing and Maturation	-	-
	Akram Point	Juvenile	-	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile and adult	-	-	-	-	-	-	-	-	-
	Harbaria	Adult	-	-	-	-	-	-	-	-	-
	Mongla Point	Fry and Adult	-	-	-	-	-	-	-	-	-
		Adult	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	Feeding and Growing	-	-	-	-
	Maidara	Juvenile and Age-1 Adult	-	-	-	-	-	Growing and Maturation	Growing and Maturation	-	-

Migratory Fish Species	Sampling Sites	Year Class*	Migration Purpose								21 <sup>st</sup> QM
			13th QM	14th QM	15th QM	16th QM	17th QM	18th QM	19 <sup>th</sup> QM	20 <sup>th</sup> QM	
		Adult	-	Feeding	-	-	-	Feeding	-	-	-
	Chalna Point	Juvenile and Age-1 Adult	-	-	-	-	-	-	Growing and Maturation	Feeding	Growing and Maturation
Hilsa	Akram Point	Brood Fish	-	-	-	-	-	-	-	-	-
	Haldikhali	Brood Fish	-	-	-	-	-	-	-	-	-
		Juvenile	-	-	-	-	-	-	-	-	-
	Harbaria	Brood Fish	-	-	-	-	-	-	-	-	-
	Chandpai	Adult and Brood Fish	-	-	-	-	-	-	-	-	-
	Mongla Point	Adult	-	-	-	-	-	-	-	-	-
		Brood Fish	-	-	-	-	-	-	-	-	-
	Maidara	Age-1 Adult	-	-	-	-	-	-	-	-	-
Pangas	Chalna Point	Adult	-	-	-	-	-	Maturation	-	-	-
		Brood fish	-	-	-	-	-	-	-	-	-
	Haldikhali	Juvenile	-	-	-	-	-	-	-	-	-
	Charaputia	Adult	-	-	-	-	-	-	-	Feeding	-
	Harbaria	Adult	-	-	-	-	-	-	-	-	-
	Mongla Point	Juvenile	-	-	-	-	-	-	Feeding and Growing	-	Feeding and Growing

Source: Field findings at different times

\*Only Age-1 to Brood fish was allowed to interpret the migration purpose; F = Feeding; Sp = Spawning

Table D.5: The Present Catch in Three Sampling Ghers

Sampling Site	Total Catch (kg): 2014-2015							
	1st QM (April, 2014)		2nd QM (July, 2014)		3rd QM		4th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	5	Bagda	6.42	Bagda	4.8	-	-
	Vetki	1.57	Bele	0	Gusha Chingri	-	-	-
	Bele	0.98	Cheng	0	Harina Chingri	-	-	-
	Harina Chingri	0.78	Bhangan	0	Rui (kg)	-	-	-
	Chali Chingri	0.11	Chali Chingri	0	Catla (kg)	-	-	-
	Chaka Chingri	0.08	-	-	-	-	-	-
Sub-total =		8.52		6.42		4.8	-	-
2	Bagda	4	Bagda	1	Bagda	7	-	-
	Harina Chingri	2	Harina Chingri	0.33	Vetki	1	-	-
	Chali Chingri	0.18	Chali Chingri	0.08	Paissa	10	-	-
	-	-	Golda Chingri	0.01	Phessa	2.4	-	-
	-	-	Bele	0.08	Bhangan	1.7	-	-
	-	-	Tengra&Paissa	0.04	Golda Chingri	0.9	-	-
Sub-total =		6.00		2.00		23	-	-
3	Bagda	1.38	Bagda	2.4	Bagda	1.5	-	-
	Harina Chingri	0.34	Harina Chingri	0.34	Paissa	10	-	-
	Chali Chingri	0.17	Chali Chingri	0.17	Tengra	10	-	-
	-	-	-	-	Bele	20	-	-
	-	-	-	-	Tilapia	22	-	-
	-	-	-	-	Rui	28	-	-
	-	-	-	-	Vetki	-	-	-
	-	-	-	-	Harina Chingri	-	-	-
	-	-	-	-	Chami Chingri	-	-	-
Sub-total =		1.89		2.91		197.5	-	-
Grand-total =		17.00		11.33		226.5	-	-

Source: CEGIS Field Survey, 2014-2015

Sampling Site	Total Catch (kg): 2015-2016							
	5th QM		6th QM		7th QM		8th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	-	Bagda	1.6	Bagda	2	Catla	2
	Horina Chingri	1	Horina Chingri	1	Horina Chingri	3.2	Glass Carp	0.1
	Tengra	-	Chali Chingri	0.5	Gusha Chingri	0.8	Horina Chingri	0.8
	Paissa	-	Paissa	0.25	Paissa	24	Minar Carp	0.1
	Chela	-	Bele	0.25	Vetki	0.2	Nilotica	1.6
	Vetki	-	-	-	Kailla	0.4	Paissa	0.6
	-	-	-	-	Bele	0	Rui	3
	-	-	-	-	Tilapia	0	Vetki	0.8
	-	-	-	-	Catla	0	-	0
	-	-	-	-	Minar Carp	0	-	0
	-	-	-	-	Glass Carp	0	-	0
	-	-	-	-	Kakra	0.4	-	0
<b>Sub-total=</b>	-	<b>1</b>	-	<b>3.06</b>	-	<b>31</b>	-	<b>9</b>
2	Bagda	-	Bagda	1.67	Bagda	0	-	0
	-	-	Chali Chingri	0.30	Horina Chingri	0	-	0
	-	-	Horina Chingri	0.50	Chali Chingri	0	-	0
	-	-	Bele	0.30	Tilapia	0	-	0
	-	-	Paissa	0.25	Vetki	0	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Paissa	0	-	0
<b>Sub-total=</b>	-	<b>0</b>	-	<b>3.02</b>	-	<b>0</b>	-	<b>0</b>
3	Bagda	-	Bagda	3.5	Bagda	0.4	-	0
	-	-	-	-	Paissa	3.2	-	0
	-	-	-	-	Vetki	0.4	-	0
	-	-	-	-	Tilapia	0.06	-	0
	-	-	-	-	Horina Chingri	0.35	-	0
	-	-	-	-	Chali Chingri	0.6	-	0
	-	-	-	-	Chaka Chingri	0.1	-	0
	-	-	-	-	Tengra	0	-	0
	-	-	-	-	Bele	0	-	0
	-	-	-	-	Tairel	0.06	-	0
	-	-	-	-	Bhangan	0	-	0
<b>Sub-total =</b>	-	-	-	-	-	<b>5.17</b>	-	<b>0</b>
<b>Grand-total =</b>	-	<b>1</b>	-	<b>3.5</b>	-	<b>36.17</b>	-	<b>9</b>

Source: CEGIS Field Survey, 2015-2016

Sampling Site	Total Catch (kg): 2016-2017							
	9th QM		10th QM		11th QM		12th QM	
	Species	ton	Species	ton	Species	ton	Species	ton
1	-	0	-	-	Bagda	3	-	0
	-	0	-	-	Tengra	0.1	-	0
	-	0	-	-	Horina Chingri	0.8	-	0
	-	0	-	-	Paissa	0.1	-	0
	-	0	-	-	Vetki	2	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
	-	0	-	-	-	0	-	0
Sub-total =	-	0	-	-	-	6	-	0
2	Bagda	1	-	-	Bagda	2	Bagda	0.0035
	Horina	0.14	-	-	Bele	1.6	Horina Chingri	0.288
	-	0	-	-	Chali Chingri	4	Paissa	0.22
	-	0	-	-	Horina Chingri	8	Tengra	0.305
	-	0	-	-	Paissa	0.28	Chela	0.45
	-	0	-	-	Tengra	0.8	Tilapia	0.53
	-	0	-	-	Tilapia	8	Vetki	0.06
	-	-	-	-	Vetki	2.4	Bele	0.15
Sub-total =		1.14	-	-	-	9	-	0
3	Bagda	2	-	-	Bagda	0.4	-	0
	-	0	-	-	Horina Chingri	0.35	-	0
	-	0	-	-	Paissa	0.06	-	0
	-	0	-	-	Tengra	0.4	-	0
	-	0	-	-	Tilapia	3.2	-	0
Sub-total =	-	2	-	-	-	4	-	2.01
Grand-total =	-	3.14	-	-	-	19	-	2.01

Source: CEGIS Field Survey, 2016-2017



Sampling Site	Total Catch (kg): 2017-2018 and 2018-19													
	13th QM		14th QM		15th QM		16th QM		17th QM		18th QM		19th QM	
	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton
1	Bagda	0	Bagda	3	-	-	Bagda	2.00	Bagda	0.76	Bagda	0	Bagda	-
	Horina Chingri	1	Rui (kg)	1.3	-	-	Golda	0.10	Bele	0.20	Catla	1.2	Paissa	-
	Tengra	0	Catla (kg)	1	-	-	Rui	0.12	Chali	1.20	Common Carp	0.3		
	Paissa	0	-	-	-	-	Grass Carp	0.20	Golda	0.00	Grass Carp	0.3		
	Chela	0	-	-	-	-	Catla	0.30	Horina	1.60	Rui	4.2		
	Vetki	0	-	-	-	-	Tilapia	0.45	Paissa	0.00				
							Horina	0.10	Tilapia	12.80				
							Gusha	0.00						
							Paissa	0.00						
							Khorulla	0.00						
							Vetki	0.00						
							Gulsha	0.00						
							Bele	0.00						
Sub-total =	-	1	-	3.6	-	-	=	3.27	=	16.56	=	6		
2	Bagda	0	Bagda	5	-	-	Bagda	3.93	Bagda	1.48	Bagda	5	Bagda	-
	-	-	Vetki	0.5	-	-	Golda	0.13	Bele	0.06	Bhangan	0.05	Paissa	-
	-	-	Paissa	7	-	-	Rui	8.41	Bhangan	0.01	Catla	3	Datina	-
	-	-	Phessa	1	-	-	Tilapia	5.90	Catla	0.00	Chali	0.4		
	-	-	Bhangan	0.7	-	-	Nilotica	0.00	Chali	0.04	Golda	0.08		
							Khorulla	0.00	Chel	0.01	Horina	1.8		
							Mrigel	0.00	Golda	0.00	Paissa	0.8		
							Catla	0.00	Horina	0.50	Rui	3		
							Grass Carp	0.11	Motka	0.05	Tengra	0.8		
							Common Carp	5.55	Paissa	0.03	Tilapia	8		
							Sarpunti	0.53	Rui	0.00	Vetki	2		
							Horina	1.91	Tengra	0.13				
							Chali Chingri	1.16	Tilapia	0.41				
							Bele	0.43	Vetki	0.01				
							Vetki	1.96						

Sampling Site	Total Catch (kg): 2017-2018 and 2018-19													
	13th QM		14th QM		15th QM		16th QM		17th QM		18th QM		19th QM	
	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton	Species	ton
							Tengra	4.20						
							Paissa	0.14						
							Tairel	0.003						
							Pheksa	0.001						
<b>Sub-total =</b>		<b>0</b>		<b>14.2</b>	-	-	=	<b>34.38</b>	=	<b>2.75</b>	=	<b>25</b>		
<b>3</b>	Bagda	0	Bagda	2	-	-	Bagda	0.50	Bagda	0.10	-	0	Bagda	-
	-	-	Paissa	8	-	-	Tilapia	1.50	Horina Chingri	0.00			Golda	-
	-	-	Tengra	2	-	-	Tengra	0.12	Paissa	0.00			Paissa	-
	-	-	Tilapia	5	-	-	Paissa	0.00	Tengra	0.00			Nilotica	-
	-	-	Rui	3	-	-	Horina Chingri	0.60	Tilapia	0.20			Khorsul	-
	-	-	Vetki	2	-	-								
	-	-	Catla	10	-	-								
<b>Sub-total =</b>	-	<b>0</b>	-	<b>32</b>	-	-								
<b>Grand-total =</b>	-	<b>1</b>	-	<b>49.8</b>	-	-	=	<b>2.72</b>	=	<b>0.30</b>	=	<b>0</b>		

Source: CEGIS Field Survey, 2017-18 and 2018-19

#### Total Catch (kg): 2019-2020

Location	20 <sup>th</sup> QM		21 <sup>st</sup> QM		22 <sup>nd</sup> QM	
	Fish Species	Total Production (ton)	Fish Species	Total Production (ton)	Fish Species	Total Production (ton)
Bhekatkhali Khal, Rajnagar	Bagda	32	Bagda	2.72	Bagda	0.8
	Horina	48	Harina	3.44	Harina	1.0
	-	-	Tilapia	0.7	Chali	0.2
	-	-	Parse	0.17	Patari	0.3
	-	-	-	-	Tairel	0.03
	-	-	-	-	Tilapia	0.5
	-	-	-	-	Datina	0.02
<b>Sub-total =</b>		<b>80</b>		<b>7.0</b>		<b>2.8</b>
Kapashdanga-Muralia	Bagda	1.41	Bagda	6.74	Bagda	3.42
	Paissa	0.60	Golda	0.01	Harina	3.96
	Crab	0.00	Harina	0.65	Chali	0.38
	Tilapia	0.30	Chali	0.04	Bele	2.11
	Golda	0.10	Bele	0.09	Paissa	2.62

Location	20 <sup>th</sup> QM		21 <sup>st</sup> QM		22 <sup>nd</sup> QM	
	Fish Species	Total Production (ton)	Fish Species	Total Production (ton)	Fish Species	Total Production (ton)
	Horina Chingri	2.92	Tilapia	0.22	Tilapia	9.85
	Chali Chingri	1.52	Tengra	0.57	Golda	0.04
	Bele	1.35	Bhangan	0.08	Tengra	0.17
	Tengra	0.27	-	-	Patari	2.25
	Major Carp	0.55	-	-	Chemo	0.02
	-	-	-	-	Datina	1.01
	-	-	-	-	Rui	1.27
	-	-	-	-	Chaka	0.01
	-	-	-	-	Kailla	0.96
	-	-	-	-	Nundi Bele	0.02
	-	-	-	-	Kakra	0.49
Sub-total =		9		8.0		29
Chunkuri-2	Bagda	0.04	Patari	0.01	Tilapia	0.02
	Paissa	0.00	Tair/Tailla	0.01	Paissa	0.066
	Khorsula	0.00	Bhangan	0.01	Khorsul	0.009
	Horina Chingri	0.10	Datina	0.03	Bagda	0.015
	Motka	0.04	Bagda	0.02	Golda	0.006
	Chali Chingri	0.03	Golda	0.03	Patari	0.015
	Chaka Chingri	0.01	Faissa	0.01	Harina	0.008
	Bele	0.01	Chaka Chingri	0.01	Chali	0.009
	Crab	0.03	Harina	0.02	China Puntti	0.047
	-	-	-	-	Tengra	0.008
	-	-	-	-	Baila	0.003
	-	-	-	-	Datina	0.02
Sub-total =		0.24		0.15		0.46

(E) Table E 1: Existing Cropping Pattern of Monitoring Agriculture Plot

Year	Cropping Season	Monitoring Spot-1 (Baranpara)	Monitoring Spot-2 (Chunkuri-2)	Monitoring Spot-3 (Kapalimet)	Monitoring Spot-4 (Chakgona)	Monitoring Spot-5 (Basherhula)	Monitoring Spot-6 (Bidyarbon_)
2013-2014	Kharif-I	Fallow	Fallow	Fallow	Fallow	Fallow	-
	Kharif-II	Local Aman	HYV Aman	Local Aman	Local Aman	Local Aman	-
	Rabi	Fallow	Fallow	Fallow	Fallow	Fallow	-
2014-2015	Kharif-I	Fallow	Fallow	Fallow	Fallow	Fallow	-
	Kharif-II	HYV Aman	Local Aman	Fallow	Fallow	Local Aman	-
	Rabi	Fallow	Fallow	Fallow	Fallow	Fallow	-
2015-2016	Kharif-I	Fallow	Fallow	Fallow	Fallow	Fallow	-
	Kharif-II	HYV Aman	HYV Aman	Fallow	Fallow	Local Aman	-
	Rabi	Fallow	Fallow	Fallow	Fallow	Fallow	-
2016-2017	Kharif-I	Fallow	Fallow	Fallow	Fallow	Fallow	-
	Kharif-II	HYV Aman	Local Aman	Fallow	Fallow	Local Aman	-
	Rabi	Fallow	Fallow	Fallow	Fallow	Fallow	-
2017-2018	Kharif-I	Fallow	Fallow	Fallow	Fallow	Fallow	-
	Kharif-II	Local Aman	Local Aman	Fallow	Fallow	Local Aman	
	Rabi	Fallow	Fallow	Fallow	Fallow	Fallow	
2018-2019	Kharif-I	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow
	Kharif-II	Local Aman	Local Aman	Fallow	Local Aman	Local Aman	Local Aman
	Rabi	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow
2019-2020	Kharif-I	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow
	Kharif-II	Local Aman	Local Aman	Fallow	Local Aman	Local Aman	Local Aman
	Rabi	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow

## (F) Traffic survey data

**Table F.1: Traffic Volume Survey at Khulna Mongla Road (Khudir Bottola)**

Date: November 13, 2019 (Wednesday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	Factor	Khulna to Mongla	Mongla to Khulna	PCU	Khulna to Mongla	Mongla to Khulna	PCU	Khulna to Mongla	Mongla to Khulna	PCU
Pedestrian	0	12	12	0	8	13	0	13	13	0
Auto Rickshaw	0.8	0	0	0	0	0	0	0	1	0
Van	0.6	38	38	45	58	59	70	8	54	37
Cycle	0.2	28	15	8	16	22	8	1	36	7
Human Howler	0.6	3	6	5	6	6	7	10	9	11
CNG	0.5	2	2	2	0	1	0	0	5	2
Private Car	1	14	28	41	21	24	45	3	20	22
Motor Cycle	0.3	72	110	55	120	109	69	3	148	45
Jeep	1	3	19	21	9	12	21	3	9	12
Pick-up	2	13	29	82	14	21	69	4	30	68
Micro	1	10	20	30	14	11	25	4	9	13
Bus	2.5	32	40	179	48	34	205	6	37	108
Light Truck	2	12	7	37	19	14	65	0	11	21
Medium Truck	2	20	19	76	40	40	159	3	67	140
Heavy Truck	2	9	8	33	10	9	37	7	12	37
			<b>Total</b>	<b>613</b>			<b>779</b>			<b>524</b>

**Table F.2: Traffic Volume Survey at Khulna Mongla Road (Digraj)**

Date: Friday 15, 2019 (Friday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	Factor	Khulna to Mongla	Mongla to Khulna	PCU	Khulna to Mongla	Mongla to Khulna	PCU	Khulna to Mongla	Mongla to Khulna	PCU
Pedestrian	0	11	5	0	7	7	0	6	11	0
Auto Rickshaw	0.8	0	0	0	0	0	0	0	0	0
Van	0.6	57	40	58	31	30	37	24	38	37
Cycle	0.2	15	9	5	8	10	3	9	14	5
Human Howler	0.6	28	15	26	17	14	19	13	22	21
CNG	0.5	21	7	14	13	11	12	15	15	15
Private Car	1	4	5	10	7	2	9	6	5	11
Motor Cycle	0.3	37	26	19	22	32	16	20	35	16
Jeep	1	6	2	8	2	2	4	2	5	7
Pick-up	2	12	6	36	8	6	26	7	8	30
Micro	1	9	5	14	5	2	7	3	5	7
Bus	2.5	17	10	68	9	8	41	12	9	50
Light Truck	2	5	1	13	1	1	3	3	1	6
Medium Truck	2	15	4	39	21	8	58	18	14	62
Heavy Truck	2	17	1	36	6	10	31	5	7	24
			<b>Total</b>	<b>346</b>			<b>264</b>			<b>289</b>




**Table F.3: Traffic Volume Survey at Power Plant access road (Ichamoti Bridge)**

Date: November 14, 2019 (Thursday)

Vehicles		7:00 AM to 10:00AM			12:00 PM to 2:00PM			17:00 PM to 19:00PM		
Direction	Factor	Babubari to Plant site	Plant site to Babubari	PCU	Babubari to Plant site	Plant site to Babubari	PCU	Babubari to Plant site	Plant site to Babubari	PCU
Pedestrian	0	15	7	0	3	3	0	30	16	0
Auto Rickshaw	0.8	0	0	0	0	0	0	0	0	0
Van	0.6	17	11	17	16	10	15	8	10	11
Cycle	0.2	7	2	2	4	5	2	1	1	0
Human Howler	0.6	17	9	16	14	18	19	10	11	12
CNG	0.5	0	0	0	0	1	0	0	0	0
Private Car	1	18	3	21	2	1	2	3	3	6
Motor Cycle	0.3	24	8	10	27	25	16	3	11	4
Jeep	1	11	3	14	3	6	9	3	8	11
Pick-up	2	7	3	20	4	5	17	4	10	28
Micro	1	9	2	12	4	3	7	4	2	6
Bus	2.5	5	2	18	1	1	5	6	3	22
Light Truck	2	1	0	3	1	1	3	0	1	2
Medium Truck	2	2	1	5	1	1	2	3	2	10
Heavy Truck	2	9	5	28	2	6	14	7	6	26
			<b>Total</b>	<b>163</b>			<b>110</b>			<b>137</b>

## Analysis results of Water quality parameters

		জীবনের জন্য বিজ্ঞান "শেখ হাসিনার দর্শন, সব মানুষের উন্নয়ন" বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর) BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (BCSIR)		
A-1191	Water (PAH) Sample: 01, Project jetty site (Total organic carbon and Total carbon)	Acenaphthylene	ND	6440.B
		Anthracene	ND	6440.B
		Benzo (A) Anthracene	ND	6440.B
		Benzo(A) Pyrene	ND	6440.B
		Benzo(B) Fluoranthene	ND	6440.B
		Benzo(G,H,I) Perilene	ND	6440.B
		Benzo(K) Fluoranthene	ND	6440.B
		Chrysene	ND	6440.B
		Dibenzo(A,H) Anthracene	ND	6440.B
		Fluorene	ND	6440.B
		Phenanthrene	ND	6440.B
		Pyrene	ND	6440.B
A-1191	Water (PAH) Sample: 01, Project jetty site (Total organic carbon and Total carbon)	(TOC) Total Organic Carbon	Less than 5.0 mg/L	5310.B
		(TOC) Total Organic Content	144 mg/L	5310.B



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Analytical Service Cell

No. Goudami Khola Road, Dharmapali, Dhaka 1205, Bangladesh



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A-1192	Water (PAH) Sample: 02, Project Harbaria (Total organic carbon and Total carbon)	Acenaphthylene	ND	6440.B
		Anthracene	ND	6440.B
		Benzo(A) Anthracene	ND	6440.B
		Benzo(A) Pyrene	ND	6440.B
		Benzo(B) Fluoranthene	ND	6440.B
		Benzo(G,H,I) Perilene	ND	6440.B
		Benzo(K) Fluoranthene	ND	6440.B
		Chrysene	ND	6440.B
		Dibenzo(A,H) Anthracene	ND	6440.B
		Fluorene	ND	6440.B
		Phenanthrene	ND	6440.B
		Pyrene	ND	6440.B
A-1192	Water (PAH) Sample: 02, Project Harbaria (Total organic carbon and Total carbon)	(TOC) Total Organic Carbon	Less than 5.0 mg/L	5310.B
		(TOC) Total Organic Content	176 mg/L	5310.B

Analyst

Section/Division In-Charge

In-Charge/Director



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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)  
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (BCSIR)

Institute Name: Institute of National Analytical Research &amp; Service (INARS)

## Analysis Report



Analytical Service Cell Ref No: Aug2019018994

Unit (Lab/Inst.) Ref No: A-1187-1190

Lab ID: INS-1187-1190

Sample Receiving Date: 18/08/2019

Sample ID: A-1187-1190

Submission Date: 08 Aug 2019

Report Delivery Date: 21/08/2019

Sample Description: Jetty site, Mongla confluence, Harbaria, Akram point

Client's Details: Mahadi Hassan  
Center For Environmental And Geographic Information Services  
House#House No. 06, , Road No. 23/C, Dhaka-1216

Number of Sample: 4

## Report Details:

Lab ID	Particulars of supplied Sample	Parameters	Concentration	Test Method (APHA)
A-1187	Water (Jetty site)	Oil and Grease	Less than 2.0 mg/L	5520.B
A-1188	Water (Mongla confluence)	Oil and Grease	Less than 2.0 mg/L	5520.B
A-1189	Water (Harbaria)	Oil and Grease	Less than 2.0 mg/L	5520.B
A-1190	Water (Akram point)	Oil and Grease	Less than 2.0 mg/L	5520.B

Analyst

Section/Division In-Charge

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Analytical Service Cell

No. 23/C, Road No. 06, Dhaka-1216



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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ (বিসিএসআইআর)  
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (BCSIR)

Institute Name: Institute of National Analytical Research &amp; Service (INARS)

## Analysis Report



Analytical Service Cell Ref No: Aug2019018990

Unit (Lab/Inst.) Ref No: A-1165-1181

Lab ID: INS-1165-1181

Sample Receiving Date: 18/08/2019

Sample ID: A-1165-1181

Submission Date: 08 Aug 2019

Report Delivery Date: 21/08/2019

Sample Description: 1. Sample no: Surface water (1-14) 2. Sample no: Groundwater (Gw-1, GW-2 and GW-3)

Client's Details: Mahadi Hassan  
Center For Environmental And Geographic Information Services  
House#House No. 06, , Road No. 23/C, Dhaka-1216

Number of Sample: 17

## Report Details:

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1165	Surface water (Sample-01)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1166	Surface water (Sample-02)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1167	Surface water (Sample-03)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1168	Surface water (Sample-04)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1169	Surface water (Sample-05)	Mercury (Hg)	Less than 0.001 mg/L	3112.B



## Note:

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A-1170	Surface water (Sample-06)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1171	Surface water (Sample-07)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1172	Surface water (Sample-08)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1173	Surface water (Sample-09)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1174	Surface water (Sample-10)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1175	Surface water (Sample-11)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1176	Surface water (Sample-12)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1177	Surface water (Sample-13)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1178	Surface water (Sample-14)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1179	Ground water (GW-01)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1180	Ground water (GW-02)	Mercury (Hg)	Less than 0.001 mg/L	3112.B
A-1181	Ground water (GW-03)	Mercury (Hg)	Less than 0.001 mg/L	3112.B

Analyst

Section/Division In-Charge



In-Charge/Director

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Analytical Service Cell

No. 6, Ghatkhuda Road, Dhaka-1205, Bangladesh

	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

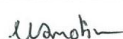
Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

Sample ID: CEN2019100201	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-01)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
3	Calcium (Ca)	75	44	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	36	mg/L	CRM	-
5	Chloride	150-600	165	mg/L	Titrimetric	-
6	Silica (SiO <sub>2</sub> )	0.0	8.1	mg/L	UVS	-
7	Bi-Carbonate (HCO <sub>3</sub> <sup>-</sup> )	0.0	120	mg/L	Titrimetric	-
8	Cr (Total)	0.05	0.009	mg/L	AAS	0.0003
9	Hardness	200-500	2100	mg/L	Titrimetric	-
10	Iron (Fe)	0.3-1	5.62	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	9	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	0.10	mg/L	UVS	0.10
14	Phosphate	6.0	10.1	mg/L	UVS	0.10
15	Potassium (K)	12.0	2	mg/L	AAS	-
16	Sodium (Na)	200	48	mg/L	AAS	0.34
17	Sulphate	400	23	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	290	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	14	mg/L	Gravimetric Method	-
20	Turbidity	10	325	NTU	Turbidity Meter	-
21	Carbonate (CO <sub>3</sub> )	-	0.56	mg/L	Titrimetric	-



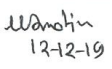
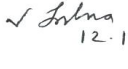

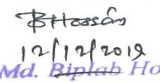



Page 1 of 2



Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
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Comments: Sample was collected & Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:		Countersigned/Approved by:	
	Signature		Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	 12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	 12.12.19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 12.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 12/12/2019 Md. Biplab Hossain

Chief Chemist  
Department of Public Health Engineering  
Central Laboratory Mohakhali, Dhaka.

	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

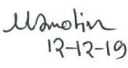
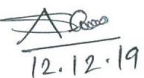
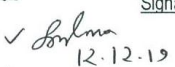
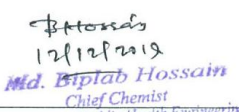
Sample ID: CEN2019100202	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-02)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**



Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00017	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	24	mg/L	CRM	-
4	Cr (Total)	0.05	0.012	mg/L	AAS	0.0003
5	Hardness	200-500	1950	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.1	mg/L	UVS	0.10
8	Phosphate	6.0	0.59	mg/L	UVS	0.10
9	Sulphate	400	19	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	150	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	11	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>  1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer  12-12-19  2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer  12.12.19	<b>Countersigned/Approved by:</b>  1.) Name: Mita Sarker Designation: Senior Chemist  12.12.19  2.) Name: Md. Biplab Hossain Designation: Chief Chemist  12/12/2019 <b>Md. Biplab Hossain</b> Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

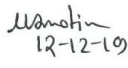

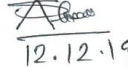
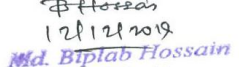
Sample ID: CEN2019100203	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-03)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	32	mg/L	CRM	-
4	Cr (Total)	0.05	0.020	mg/L	AAS	0.0003
5	Hardness	200-500	1900	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.2	mg/L	UVS	0.10
8	Phosphate	6.0	0.49	mg/L	UVS	0.10
9	Sulphate	400	21	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	152	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	13	mg/L	Gravimetric Method	-



Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	 12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	 12-12-19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 12.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 12/12/2019 <b>Md. Biplab Hossain</b> Chief Chemist

Department of Public Health Engineering  
Central Laboratory Mohakhali, Dhaka.



	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

Sample ID: CEN2019100204	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-04)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
3	Calcium (Ca)	75	36	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	20	mg/L	CRM	-
5	Chloride	150-600	70	mg/L	Titrimetric	-
6	Silica (SiO <sub>2</sub> )	0.0	7.8	mg/L	UVS	-
7	Bi-Carbonate (HCO <sub>3</sub> <sup>-</sup> )	0.0	95	mg/L	Titrimetric	-
8	Cr (Total)	0.05	0.074	mg/L	AAS	0.0003
9	Hardness	200-500	1850	mg/L	Titrimetric	-
10	Iron (Fe)	0.3-1	5.84	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.009	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	8	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	1.5	mg/L	UVS	0.10
14	Phosphate	6.0	0.60	mg/L	UVS	0.10
15	Potassium (K)	12.0	1	mg/L	AAS	-
16	Sodium (Na)	200	46	mg/L	AAS	0.34
17	Sulphate	400	16	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	205	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	12	mg/L	Gravimetric Method	-
20	Turbidity	10	275	NTU	Turbidity Meter	-
21	Carbonate (CO <sub>3</sub> )	-	0.18	mg/L	Titrimetric	-

Mamun

Rahman

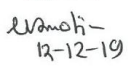

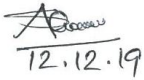
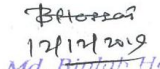
A. Ghosh

B. Hossain



Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
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Comments: Sample was collected & Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:		Countersigned/Approved by:	
	Signature		Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	 12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	 12-12-19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 12.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 12/12/2019 Md. Biplab Hossain Chief Chemist

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Central Laboratory Mohakhali, Dhaka.

	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

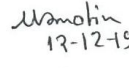
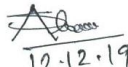
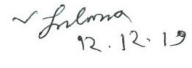
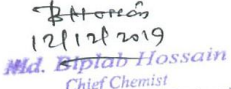
Sample ID: CEN2019100205	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-05)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**



Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	28	mg/L	CRM	-
4	Cr (Total)	0.05	0.036	mg/L	AAS	0.0003
5	Hardness	200-500	2500	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.5	mg/L	UVS	0.10
8	Phosphate	6.0	0.58	mg/L	UVS	0.10
9	Sulphate	400	17	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	142	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	13	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>  1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer  Signature:  12-12-19  2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer  Signature:  12-12-19	<b>Countersigned/Approved by:</b>  1.) Name: Mita Sarker Designation: Senior Chemist  Signature:  12.12.19  2.) Name: Md. Biplab Hossain Designation: Chief Chemist  Signature:  12/12/2019 <b>Md. Biplab Hossain</b> Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

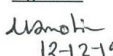

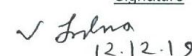
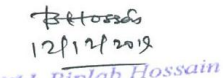
Sample ID: CEN2019100206	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-06)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019



**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00018	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	24	mg/L	CRM	-
4	Cr (Total)	0.05	0.009	mg/L	AAS	0.0003
5	Hardness	200-500	2550	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.009	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.1	mg/L	UVS	0.10
8	Phosphate	6.0	0.90	mg/L	UVS	0.10
9	Sulphate	400	19	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	150	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	14	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>  1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer  Signature:  12-12-19  2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer  Signature:  12-12-19	<b>Countersigned/Approved by:</b>  1.) Name: Mita Sarker Designation: Senior Chemist  Signature:  12-12-19  2.) Name: Md. Biplab Hossain Designation: Chief Chemist  Signature:  12-12-2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
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	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

Sample ID: CEN2019100207	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-07)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.003	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00026	mg/L	AAS	0.00015
3	Calcium (Ca)	75	52	mg/L	AAS	0.17
4	Chemical Oxygen Demand (COD)	4.0	28	mg/L	CRM	-
5	Chloride	150-600	73	mg/L	Titrimetic	-
6	Silica (Sio <sub>2</sub> )	0.0	6.6	mg/L	UVS	-
7	Bi-Carbonate (HCO <sub>3</sub> <sup>-</sup> )	0.0	120	mg/L	Titrimetic	-
8	Cr (Total)	0.05	0.008	mg/L	AAS	0.0003
9	Hardness	200-500	1700	mg/L	Titrimetic	-
10	Iron (Fe)	0.3-1	4.86	mg/L	AAS	0.05
11	Lead (Pb)	0.05	0.012	mg/L	AAS	0.001
12	Magnesium (Mg)	30-35	11	mg/L	AAS	0.05
13	Nitrogen (Nitrate)	10.0	1.5	mg/L	UVS	0.10
14	Phosphate	6.0	11.1	mg/L	UVS	0.10
15	Potassium (K)	12.0	3	mg/L	AAS	-
16	Sodium (Na)	200	58	mg/L	AAS	0.34
17	Sulphate	400	15	mg/L	UVS	1.0
18	Total Dissolved Solid (TDS)	1000	208	mg/L	Multimeter	-
19	Total Suspended Solid (TSS)	10	13	mg/L	Gravimetric Method	-
20	Turbidity	10	526	NTU	Turbidity Meter	-
21	Carbonate (CO <sub>3</sub> )	-	0.14	mg/L	Titrimetic	-



Usman

Jahna

A. B. B. B.

B. B. B. B.



	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

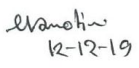
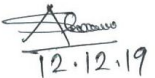

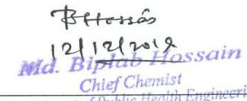
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Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-10)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.003	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	24	mg/L	CRM	-
4	Cr (Total)	0.05	0.010	mg/L	AAS	0.0003
5	Hardness	200-500	2000	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	3.1	mg/L	UVS	0.10
8	Phosphate	6.0	0.46	mg/L	UVS	0.10
9	Sulphate	400	18	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	940	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	15	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

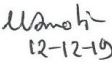

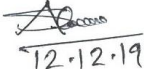
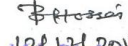
N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>  1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer  2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	<b>Signature</b>  12-12-19   12-12-19	<b>Countersigned/Approved by:</b>  1.) Name: Mita Sarker Designation: Senior Chemist  2.) Name: Md. Biplab Hossain Designation: Chief Chemist	<b>Signature</b>  12-12-19   12-12-19 <b>Md. Biplab Hossain</b> Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
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Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
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Comments: Sample was collected & Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:		Countersigned/Approved by:	
	Signature		Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	 12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	 12.12.19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 12.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 <b>Md. Biplab Hossain</b> Chief Chemist

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Central Laboratory Mohakhali, Dhaka.

	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

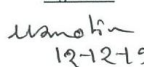


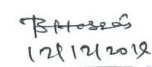
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Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-08)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**



Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00020	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	20	mg/L	CRM	-
4	Cr (Total)	0.05	0.012	mg/L	AAS	0.0003
5	Hardness	200-500	1850	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.006	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.7	mg/L	UVS	0.10
8	Phosphate	6.0	0.79	mg/L	UVS	0.10
9	Sulphate	400	16	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	145	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	12	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>		<b>Countersigned/Approved by:</b>	
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Signature  12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	Signature  12.12.19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	Signature  12.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	Signature  12/12/2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.



	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

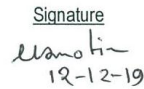
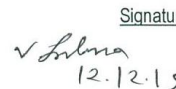
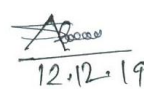
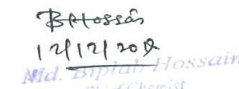
Sample ID: CEN2019100209	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-09)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019



**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00017	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	32	mg/L	CRM	-
4	Cr (Total)	0.05	0.023	mg/L	AAS	0.0003
5	Hardness	200-500	1700	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	0.5	mg/L	UVS	0.10
8	Phosphate	6.0	0.82	mg/L	UVS	0.10
9	Sulphate	400	14	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	154	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	13	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>		<b>Countersigned/Approved by:</b>	
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Signature  12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	Signature  12.12.19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	Signature  12.12.19	2.) Name: Md. Biplob Hossain Designation: Chief Chemist	Signature  12/12/2019 Md. Biplob Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

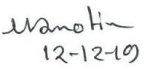


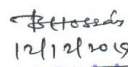
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Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-11)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**



Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.004	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00016	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	20	mg/L	CRM	-
4	Cr (Total)	0.05	0.008	mg/L	AAS	0.0003
5	Hardness	200-500	2200	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	2.5	mg/L	UVS	0.10
8	Phosphate	6.0	0.81	mg/L	UVS	0.10
9	Sulphate	400	12	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	365	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	12	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>		<b>Countersigned/Approved by:</b>	
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Signature  12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	Signature  12-12-19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	Signature  12-12-19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	Signature  12-12-19 <b>Md. Biplab Hossain</b> Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.



	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

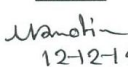
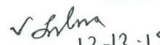

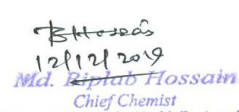
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Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-12)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019



**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	24	mg/L	CRM	-
4	Cr (Total)	0.05	0.007	mg/L	AAS	0.0003
5	Hardness	200-500	1800	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.8	mg/L	UVS	0.10
8	Phosphate	6.0	0.58	mg/L	UVS	0.10
9	Sulphate	400	14	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	172	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	13	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	 12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	 12-12-19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 12.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 12/12/2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

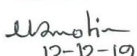
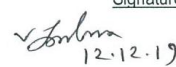
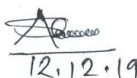
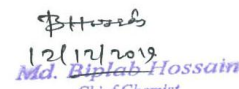
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Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-13)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019



**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	32	mg/L	CRM	-
4	Cr (Total)	0.05	0.005	mg/L	AAS	0.0003
5	Hardness	200-500	1400	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.006	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.7	mg/L	UVS	0.10
8	Phosphate	6.0	0.55	mg/L	UVS	0.10
9	Sulphate	400	16	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	560	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	12	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>		<b>Countersigned/Approved by:</b>	
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	Signature  12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	Signature  12.12.19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	Signature  12.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	Signature  12.12.2019 <b>Md. Biplab Hossain</b> Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

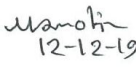
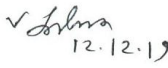
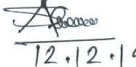
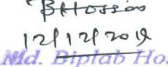
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Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Surface Water
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (SW-14)	Union:, Vill.:
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Cadmium (Cd)	0.005	0.00067	mg/L	AAS	0.00015
3	Chemical Oxygen Demand (COD)	4.0	220	mg/L	CRM	-
4	Cr (Total)	0.05	0.001	mg/L	AAS	0.0003
5	Hardness	200-500	4300	mg/L	Titrimetric	-
6	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
7	Nitrogen (Nitrate)	10.0	1.3	mg/L	UVS	0.10
8	Phosphate	6.0	0.48	mg/L	UVS	0.10
9	Sulphate	400	980	mg/L	UVS	1.0
10	Total Dissolved Solid (TDS)	1000	12500	mg/L	Multimeter	-
11	Total Suspended Solid (TSS)	10	7	mg/L	Gravimetric Method	-



Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	 12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	 12.12.19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 12.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 12/12/2019 <b>Md. Biplab Hossain</b> Chief Chemist

Department of Public Health Engineering  
Central Laboratory Mohakhali, Dhaka.



	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

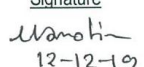

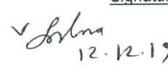
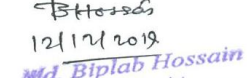
Sample ID: CEN2019100215	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Tube Well
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (GW-01)	Union:, Vill.: Project Site, Rajnagar
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019



**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	97	mg/L	Titrimetric	-
4	Lead (Pb)	0.05	0.018	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	1.4	mg/L	UVS	0.10
6	Phosphate	6.0	0.26	mg/L	UVS	0.10
7	Sulphate	400	1	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	25	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	1	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b>  1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer  2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	<b>Signature</b>  12-12-19   12.12.19	<b>Countersigned/Approved by:</b>  1.) Name: Mita Sarker Designation: Senior Chemist  2.) Name: Md. Biplab Hossain Designation: Chief Chemist	<b>Signature</b>  12.12.19   12/12/2019 <b>Md. Biplab Hossain</b> Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
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	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

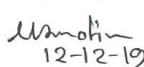
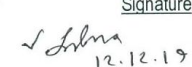

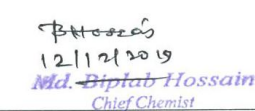
Sample ID: CEN2019100216	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Tube Well
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (GW-02)	Union: Vill.: Karpasdanga, Rajnagar
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.027	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	167	mg/L	Titrimetic	-
4	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	2.7	mg/L	UVS	0.10
6	Phosphate	6.0	4.03	mg/L	UVS	0.10
7	Sulphate	400	2	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	602	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	4	mg/L	Gravimetric Method	-



Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	 12-12-19	1.) Name: Mita Sarker Designation: Senior Chemist	 12.12.19
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 12.12.19	2.) Name: Md. Biplob Hossain Designation: Chief Chemist	 12/12/2019 Md. Biplob Hossain Chief Chemist

Department of Public Health Engineering  
Central Laboratory Mohakhali, Dhaka.



	<b>Government of the People's Republic of Bangladesh</b> <b>Office of the Chief Chemist</b> <b>Department of Public Health Engineering</b> <b>Central Lab, 38-39, Mohakhali C/A, Dhaka-1212</b> Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com	
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Lab Memo: 536/ CC, DPHE, CL, Dhaka.

Date: 12-12-2019

**Physical /Chemical/ Bacteriological Analysis of Water Sample**

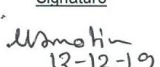
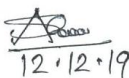
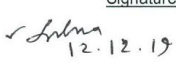
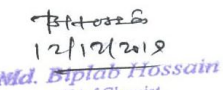
Sample ID: CEN2019100217	Sample Receiving date: 07-08-2019
Ref. Memo No: 42.06.2626.119.37.001.19-1514 & Dated: 07-08-2019	Sample Source: Tube Well
Sent by: Md. Mutasim Billah, Program Leader, CEGIS, Gulshan-1, Dhaka-1212.	Dist: Bagerhat, Upa: Rampal
Care Taker: CEGIS (GW-03)	Union:, Vill.: Rajnagar
Sample Collection date:	Date of Testing: 07/08/2019-25/09/2019

**LABORATORY TEST RESULTS:**

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Hardness	200-500	212	mg/L	Titrimetric	-
4	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
5	Nitrogen (Nitrate)	10.0	1.3	mg/L	UVS	0.10
6	Phosphate	6.0	2	mg/L	UVS	0.10
7	Sulphate	400	1	mg/L	UVS	1.0
8	Total Dissolved Solid (TDS)	1000	360	mg/L	Multimeter	-
9	Total Suspended Solid (TSS)	10	2	mg/L	Gravimetric Method	-

Comments: Sample was collected &amp; Supplied by client.

N.B: AAS - Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

<b>Test Performed by:</b> 1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer Signature:  12-12-19 2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer Signature:  12-12-19	<b>Countersigned/Approved by:</b> 1.) Name: Mita Sarker Designation: Senior Chemist Signature:  12-12-19 2.) Name: Md. Biplab Hossain Designation: Chief Chemist Signature:  12-12-2019 <b>Md. Biplab Hossain</b> Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.
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Data Table- Air Quality Analysis Result

Experiment Date	Sample Location ID	Concentration present of different parameter in ambient air ( $\mu\text{g}/\text{m}^3$ )							Remarks
		PM <sub>2.5</sub>	PM <sub>10</sub>	SPM	SO <sub>2</sub>	NO <sub>x</sub>	CO	O <sub>3</sub>	
31/10/2019	SL1	29.64	98.15	127.79	19.32	15.63	0	11	Complies
01/11/2019	SL2	14.65	79.92	109.25	56.50	55.08	0	6	Complies
02/11/2019	SL3	51.32	127.65	183.56	31.53	24.97	16	10	Complies
03/11/2019	SL4	19.34	82.27	120.45	60.26	58.39	11	22	Complies
05/11/2019	SL5	27.76	67.89	90.31	45.81	44.92	2	16	Complies
06/11/2019	SL6	33.20	119.34	175.13	54.02	43.45	0	2	Complies
07/11/2019	SL7	33.74	78.27	100.95	35.42	40.09	0	38	Complies
08/11/2019	SL8	31.28	69.32	102.17	59.33	57.02	0	52	Complies
11/11/2019	SL9	18.65	59.19	78.09	49.72	41.91	24	18	Complies
12/11/2019	SL10	39.69	64.12	83.90	57.24	46.58	48	40	Complies
13/11/2019	SL11	36.66	91.10	123.5	59.41	51.09	18	12	Complies
14/11/2019	SL12	36.67	87.15	122.62	35.23	31.26	24	90	Complies
15/11/2019	SL13	24.03	119.28	147.29	44.29	17.72	0	226	Complies
Units		$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	ppb	
Test Duration (Hours)		24	8	8	8	8	8	8	
Method of Analysis		Gravimetric	Gravimetric	Gravimetric	West-Gaeke	Jacob and Hochheiser	CO Meter	O <sub>3</sub> Meter	
Bangladesh (DoE) Standard for ambient Air		65	150	200	365	100	10,000	157	
IFC/WB Standard		75	150	NF	125	200	NF	160	

### 5.0 Terminology:

1. Fine Particulate Matter (PM<sub>2.5</sub>), 2. Respirable Dust Content (PM<sub>10</sub>), 3. Suspended Particulate Matter (SPM), 4. Oxides of Nitrogen (NO<sub>x</sub>), 5. Sulphur Di-Oxide (SO<sub>2</sub>), 6. Carbon Monoxide (CO), 7. Ozone (O<sub>3</sub>) & 8. DoE- Department of Environment, NF – Not found.

### 6.0 Comment

The above result for ambient air quality monitoring shows the PM<sub>2.5</sub>, PM<sub>10</sub>, SPM, SO<sub>2</sub>, NO<sub>x</sub> & CO concentrations of the ambient air. From the above analysis it is observed that the concentration of all the parameters are below the allowable limit as per Bangladesh Standard and International standard for ambient air. Caution shall be taken in location **SL3** which is the South-West corner of the project Boundary, Moidara due to its high particulate matter concentration in the air.